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Contract Report

June 1993

An Investigation Conducted by
Adaptive Research Corporation
Huntsville, AL

STRUCTURED FINITE VOLUME MODELING OF U.S. NAVY AIRCRAFT ENGINE TEST CELLS

TASK 1: TURBOSHAFT ENGINE -

CODE DOCUMENTATION AND LISTINGS - VOLUME 2

Abstract Volume 1, Final Report, presents results of the numerical simulation of a U.S. Naval turboshaft test cell facility. The ultimate purpose of this simulation was to provide the Navy with a numercial model to be used for the evaluation of the aerothermal performance of test cells. This simulation was performed using the structured finite volume (SFV) computer code. A description of the physical model, mathematical details, boundary conditions, and results of the study are presented and covered in this report.

Volume 2, Code Documentation and Listings, provides a copy of the input files developed for the modeling of turboshaft test cells.

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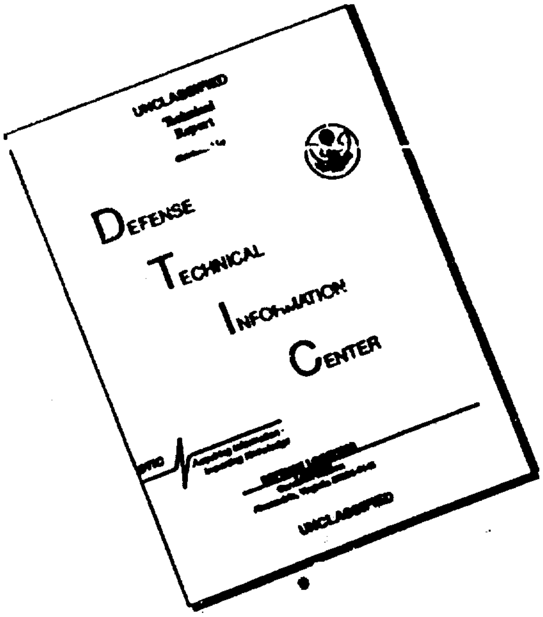

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Acquiring Information -
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

inches
1
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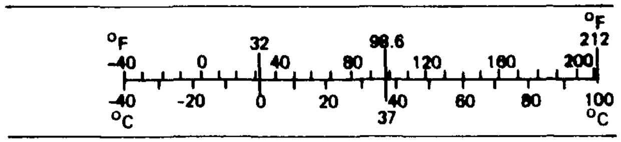
Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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13. ABSTRACT *(Maximum 200 words)*

This report presents results of the numerical simulation of a U.S. Naval turboshaft test cell facility. The ultimate purpose of this simulation was to provide the Navy with a numercial model to be used for the evaluation of the aerothermal performance of test cells. This simulation was performed using the structured finite volume (SFV) computer code. A description of the physical model, mathematical details, boundary conditions, and results of the study are presented and covered in Volume 1.

Volume 2, Code Documentation and Listings, provides a copy of the input files developed for the modeling of turboshaft test cells.

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1. INTRODUCTION

1.1 Purpose of the Report

This report provides a copy of the input files developed for the modeling of turboshaft test cells. These copies are contained in the Appendices of this report and are described briefly below. A detailed discussion of building a computational grid for this project is provided in the second section of this report. The results of the turboshaft test cell modeling are reported in the first volume of this report.

1.2 The Listings Provided

The listings are contained in Appendices B through D. Appendix B contains the Q1 input file, Appendix C contains the FORTRAN SATELLITE program, and Appendix D contains the FORTRAN GROUND file. Sketches are provided in Appendix A.

2. USER SECTION

2.1 Grid Generation

In this section a detailed discussion for the creation of a computational grid is supplied. The bulk of the input for this model deals with producing a computational grid. The code was designed for relatively easy modifications with the flexibility to model a range of changes as called for in the scope of work.

The premise of this procedure is that a 2–dimensional package will be used to create various cross sectional planes. These planes will then be stacked, blended or rotated to create the final 3–dimensional computational grid. In general, the program works as follows: 1.) the user specifies all the inputs necessary for the creation of all the various 2–dimensional cross sectional (X–Y) planes inside the standard input files (Q1 and SATLIT), 2.) the standard input files are then executed to produce the data files needed for the 2–dimensional grid generation program (EasyMesh2D or GGP), 3.) GGP is then executed for each data plane produced, and 4.) the standard input files are re–executed to produce the final grid and the other input files needed for the solver.

The standard input files will create 5 or 6 types of X–Y planes. Each plane can have several different varieties or subsets. The first type (TYPE 1) of plane is used to describe the area around the dynamometer. The planes are broken down into various regions in the X and Y directions. The user must specify the total distance from the origin for each region, the number of cells in each region, and the clustering factor for the griding of each region. Each of these will be detailed later in this section.

The second type (TYPE 2) is used to describe the X–Y cross section of the engine. The third type (TYPE 3) may or may not be used. This type is used if the exit of the engine falls close to the augmenter tube or even inside the tube. This type will be used if the gap distance is less than approximately 6 inches. This type of plane is used to improve the orthogonality in this region. TYPE 4 is used for X–Y cross section that across the augmenter tube. The fifth type (TYPE 5) is used to describe the front face of the chimney. The final type (TYPE 6) is used to describe the exit plane. Additional information may be supplied in the input files.

The file name nomenclature for the data files for the GGP is that the file name starts with the letter CS. Then numbers are added as suffixes starting at 61 and continuing until all planes are created. The data files are generally created in order with the exception of CS61. This file is created after CS63. For TYPE 1 there are three different subsets (CS files) created. The first (CS62) is used to describe the geometry in front of the dynamometer, the second (CS63) produces a cross section of the dynamometer, and the last (CS61) describes the inlet plane.

CS63 is an accurate representation of an X–Y plane through the dynamometer. CS62 is identical to CS63 with the exception that the circle of the dynamometer has become a square to help orthogonality. Its location is at the midpoint between the end of the inlet baffles and the start of the cart. CS61 is identical to CS62 with the exception that one line has been moved to correspond to the dimensions of the inlet opening. CS61 is located at the front of the test cell.

For TYPE 1 files there are 13 regions that are defined in the X–direction and 10 regions are used in the definition for the griding in the Y–direction. For each region the following information is needed

- The number of cells of each region,
- The distance to the end of the region, and
- A grid clustering factor.

The nomenclature for each of these variables is given in the Q1 file. They are noted in Figure 1 of this report. In this figure the regions in both directions for CS62 are noted along with distance and clustering nomenclature. This input is used primarily for the description of lines and arcs in the data files for GGP. Figure 2 is the copy of a graphical display produced during the creation of the 2–D grid file. In this figure the full grid is displayed. Similarly plots for CS63 and CS61 are supplied. In general, the data supplied for CS62 is used for CS63 and CS61. The dimension of the dynamometer opening is used to calculate the corresponding square in CS62. This is why some of the data for distance of each region is set to 0.000000. A integer array is used as a marker to note the first region that contains an arc. The variable XINL is the X–direction length of the inlet baffles.

Note in Figure 4 that it appears that lines overlap in the circular region. This is because some lines are overwritten with arc data. If this persists after a redraw the GGP, major problems with the grid exist. More details in regard to the execution of GGP will be given later in this section.

The coding was designed so that major changes would be fairly straight forward. The input files has slots for 14 regions in each direction so that if more regions are needed in the future the accommodations can be made. Also, the number of cells for each region in the remaining types are not required but are obtained from the number of cells supplied for each region in TYPE 1.

TYPE 2 data produces one or two CS files. The first is for the engine inlet and the last is for the engine outlet (which may be produced from TYPE 3). Since there is less complexity in this area only eight regions are needed to describe the regions in both the X– & Y–directions. Basically the area on the cart (X–direction) and the area between the cart and the top of the dynomometer exhaust shirt (Y–direction) are rearranged in to fewer regions as compared with TYPE 1 data. Also, in the circular region additional cells are picked up since the diameter of the engine inlet is larger than the dynamometer opening. These are controlled by variables NXAD and NYAD. Note that the summation of the total number of cells over each TYPE is constant.

The regions and the initial grid for CS64 is shown in Figures 7 and 8. When the initial grid is completed, the orthogonality of corner points of the circle can be improved (note Figure 9 and 10). This is done in the smoothing operations of the GGP. The number of cells affected by this is controlled by the variable ISOL located in the SATLIT file. In general these values will not need to be adjusted.

In the form delivered, TYPE 3 data is used. This data is used to produce a circle in a circle grid form. TYPE 3 data produces two or three CS files. The first is for the exit of the engine which is also the same as for the inlet of the augmenter tube. The second is for the end of the augmenter lip. A third cross section may be required if the exit of the engine falls within the lip or within the sleeve. See Appendix A for more details. The only difference in these CS files will be the diameter of the two circles. Since the diameter of augmenter tube is larger than the engine exit additional cells are needed. The number of cells is controlled by variables NXBD and NYBD. For the case delivered two CS files

(CS65 and CS66) were produced. The regions and initial grids for TYPE 3 are shown in Figure 11 through 15. In Figures 13 and 14 the initial and final (smoothed) grids are displayed.

TYPE 4 data will produce two or three CS files. If TYPE 3 data is used it will produce two files. The first file is for the augmenter lip (not produced when TYPE 3 is used), the second is for the augmenter sleeve, and the last is for the augmenter tube. The difference in these files are due to the different diameters. The regions and grids (CS67 and CS68) are shown in Figure 16 through 18.

TYPE 5 data produces one CS file (CS69). It is located at the front of the chimney. This is the plane that is rotated. This file has two options. The first is for a square duct and the second is for a round duct. This is the first cross section in which the first region does not start at a 0.0 X–coordinate value. A integer array element noted in the Q1 files takes this into account. A plot of the grid is shown in Figure 19.

The last grid is denoted by TYPE 6. It is located at the exit of the chimney. The input needed to produce this data file is taken from previously supplied information. The grid for CS70 is shown in Figure 20.

There is a integer array element that represents the stage of grid development. It is located in Group 6 of the Q1 file as is called IG (1). If the value of this element is set to 1, when the input files are executed, they will produce a set of data files for the GGP. If it is set to 2, then it will read the grid files produced by the GGP and create a 3–dimensional grid along with the other input files for the solver. If the grid is already created the value is set to 3 in order to bypass the grid creation coding.

In the form delivered, 10 data files for the GGP will be created during the first execution of the input files. At this time the user will then execute GGP as indicated in the documentation (probably done by entering runezm). The first item needed will be terminal type. Enter the appropriate value. Following this prompt, menus will appear on the screen. The following series of commands will go through these menus and produce a grid file.

PROMPT	ENTER	COMMENT
Model name	CS61	Use same name as file to be read in
EZ2 >	RE CS61	Reads in input file
EZ2 >	WR	Goes to menu to write grid
WRITE >	END	Writes grid
EZ2 >	END	End session

This is done when the grid to be produced is totally orthogonal (i.e. no circles). After the input file is read a redraw of the screen can be done through the REDR command. If lines cross after this point there is an error in the input file for the GGP. Looking at the grid may give clues as to the cause of the problem. If a grid needs to be smoothed (all files that contains a circle), the following commands will be needed.

PROMPT	ENTER	COMMENT
Model Name:	CS63	Use same name as file to be read in
EZ2 >	RE CS63	Reads in input file
EZ2 >	SM	Goes to smoothing menu
SMOOTH >	SO	Solves differential equations
SMOOTH >	REDR	Plots final grid
SMOOTH >	END	Returns to main menu
EZ2 >	WR	Goes to menu to write grid
WRITE >	END	Writes grid
EZ2 >	END	End session

After the creation of these 2–dimensional grid files, input in Q1 file is required for the formation of the final 3–dimensional grid. As in the specification of the grid in the X and Y–directions, the user must supply the number of regions, the distance to the end of the region, the number of cells, and the grid clustering factor. Allocations for 25 regions in the axial direction have been provided. As delivered, 24 have been specified.

The user must then supply the information for the building of the final grid. Four options are available 1.) Stack, 2.) Blend, 3.) Rotate, and 4.) End. Throughout the test cell the first two options are used to stack and blend the 2–dimensional grid files as needed, while the last two options create the grid in the chimney region. This information is passed to the SATLIT from the Q1 through an integer array.

2.2 Other Input

In group 9 of the input files most of the data for the physics of the model is supplied. These deal with flow rates, temperatures, mass fractions, etc. These are documented in the input files.

2.3 Relaxation

Relaxation is a numerical technique that allows the rate of change of various solved variables to be controlled. It is generally used to dampen the amount of change computed by the various computer codes. There are many views on the optimum settings of the relaxation parameters. In a problem of this size time constraints reduce the amount of effort in optimization of these parameters. The approach used was to reduce the relaxation (base values calculated on a cell residence time) at the start of a computational run and then apply tighter relaxation after a few hundred solution sweeps through the calculation domain.

The values of the relaxation parameters is given in the following table.

Table 1. Relaxation Parameters

Variable	Type	Initial Value	Final Value
P1	LINRLX	0.15	0.10
U1	FALSDT	0.0005	0.00025
V1	FALSDT	0.0005	0.000025
W1	FALSDT	0.0005	0.00025
KE	LINRLX	0.10	0.10
EP	LINRLX	0.10	0.10
H1	FALSDT	0.001	0.0005
C1	FALSDT	0.001	0.0005
C2	FALSDT	0.001	0.0005

Note the two types of relaxations are discussed in the users guide. The final values were used after sweep 421. (See following section for procedure to change relaxation.)

2.4 Other Controls

Depending on computer systems, it may take a few weeks to obtain a fully converged solution. The code allows for restarts using previous data. For some cases this may not be the best procedure as compared to one long run. Because of this various controls were put in the GROUND coding that allows the user to vary items during one long run. This coding allows the user to:

1. Abort a run with standard output produced,
2. Modify pressure relaxation,
3. Modify turbulence relaxation,
4. Modify velocity relaxation,
5. Modify scalar relaxation,
6. Dump a restart file on demand,
7. Change frequency of monitor printout,
8. Change frequency of residual printout,
9. Change the number of variables in the monitoring values printed, and
10. Change two monitor locations.

This is accomplished by:

1. Providing a file called ABORT,
2. Providing a value in the F12.8 Format in a file called RELAXP,
3. Providing two values in the 2F12.8 Format in a file called RELAXT,
4. Providing three values in the 3F12.8 Format in a file called RELAXV,
5. Providing three values in the 3F12.8 Format in a file called RELAXS,
6. Providing a file called DUMPIT,
7. Providing a value in the I5 Format in a file called TSTMOD,
8. Providing a value in the I5 Format in a file called NPRMOD,

9. Providing four values in the 4I2 Format in a file called IGGMOD (value of 1 activates printout while a value of 0 deactivates), and
10. Provide three values in the 3I3 Format in a file called ML2MOD or ML3MOD (values are for the IX, IY, and IZ locations).

2.5 Additional Printout

In addition to the standard output the following printout is provided:

1. Ten monitoring locations,
2. The maximum and minimum values for certain variables,
3. Convergence information,
4. Pumping ratios, and
5. Heat transfer information.

Note the previous section provided some information about control of the monitoring printout. The max–min printout may give clues to problem areas. Monitoring printout can then be shifted to these locations. The convergence information gives a mass and momentum error based on mass and momentum sources. A value of under 1% for mass and 3% for momentum should be acceptable. In addition the pumping ratios are printed for the dynamometer and the engine. When these value become asymptotic, this may indicate convergence. Printout is also provided for the heat transfer through the augmenter tube in the building and in the chimney. Similiarly asymptotic values point toward convergence.

FIGURES

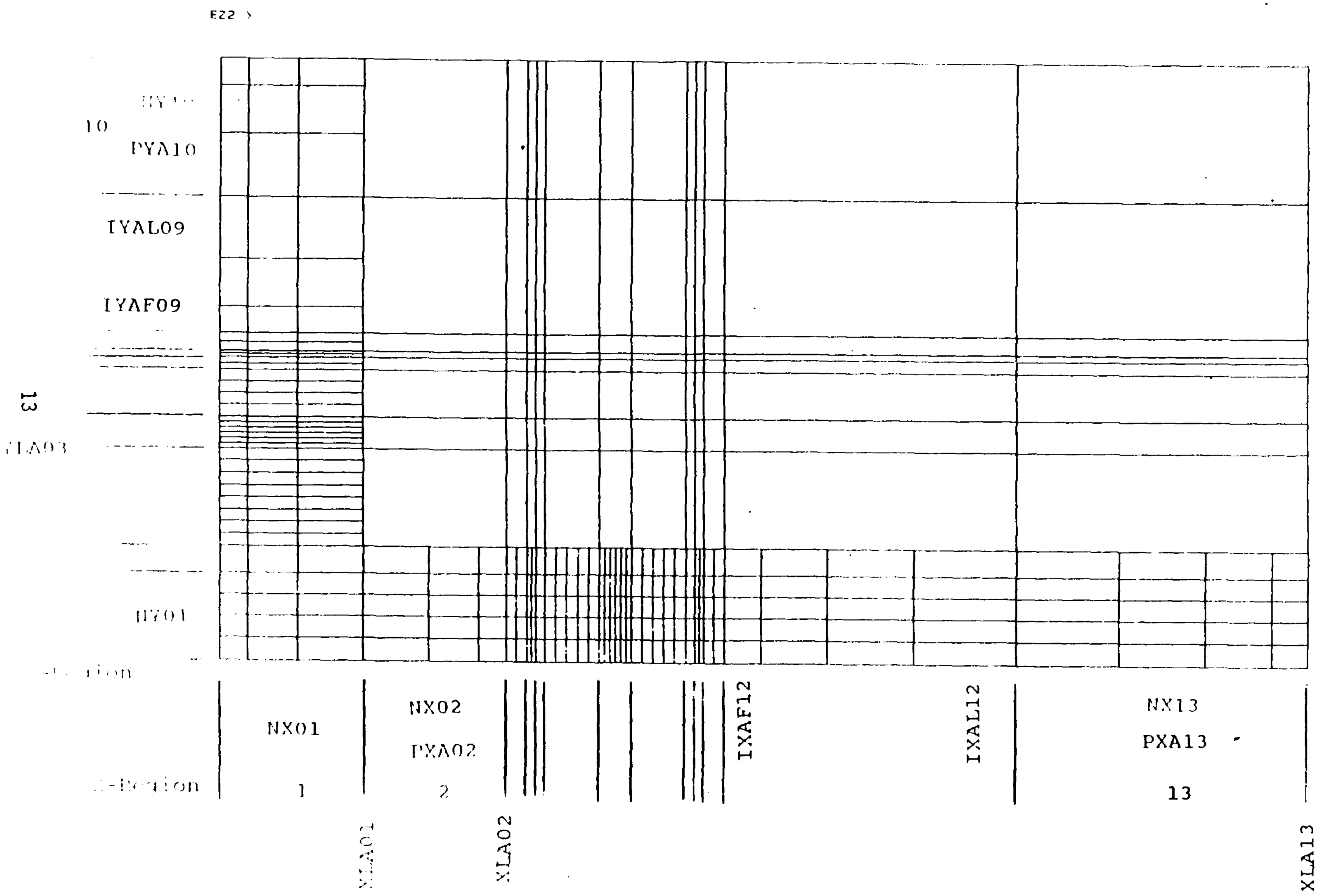


Figure 1. Regions of CS62

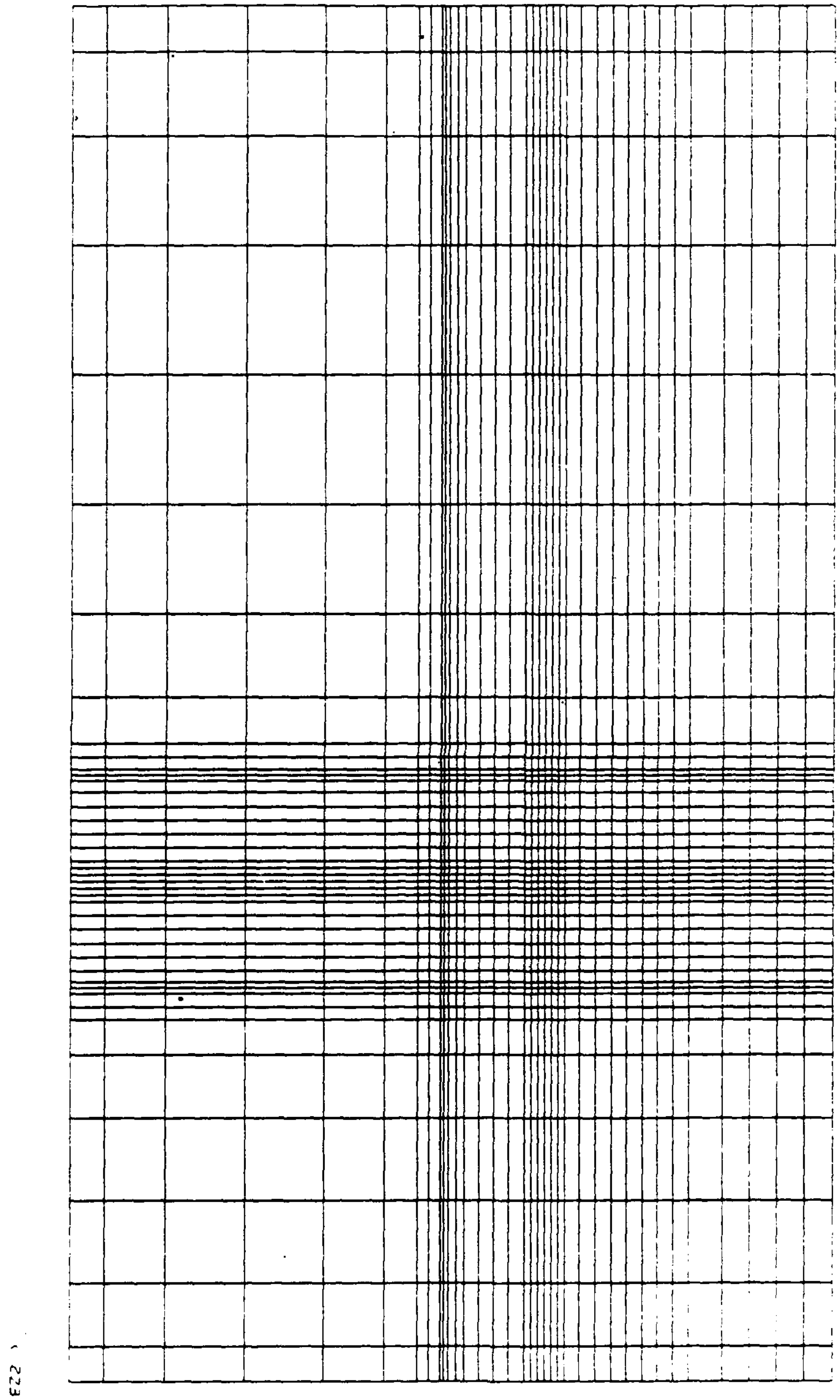


Figure 2. Grid of CS62

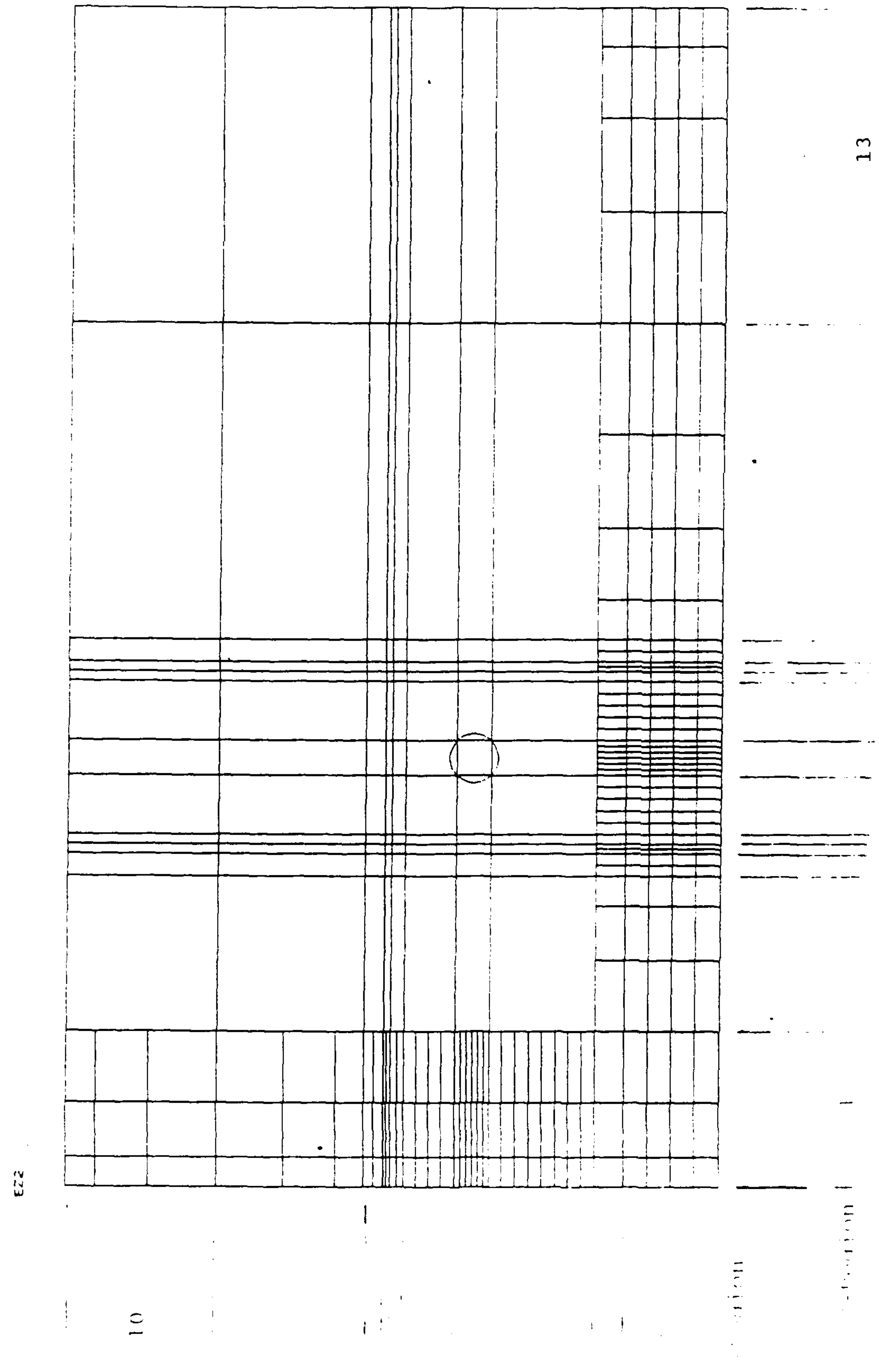


Figure 3.. Regions of CS63

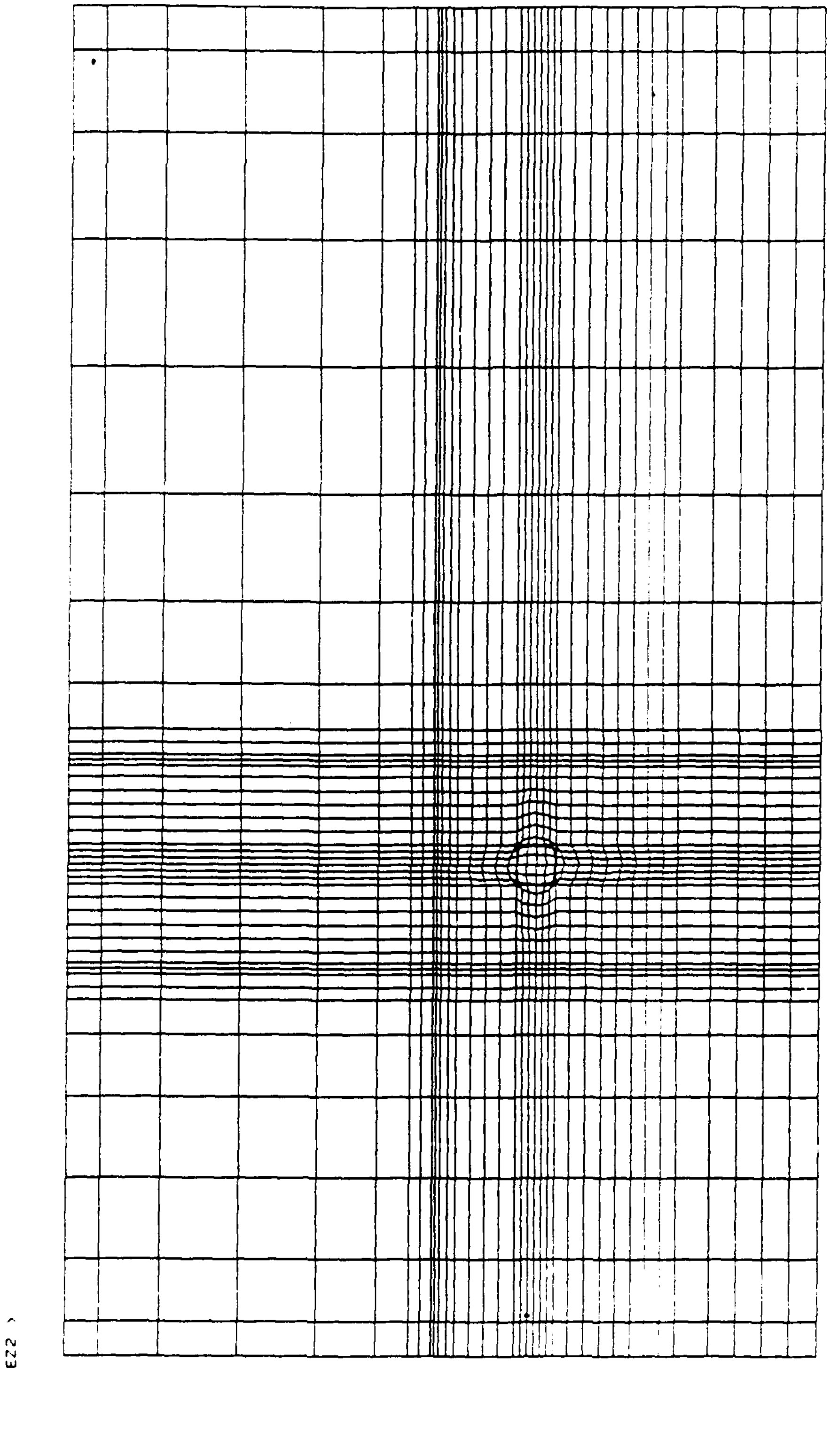


Figure 4. Initial Grid of CS63

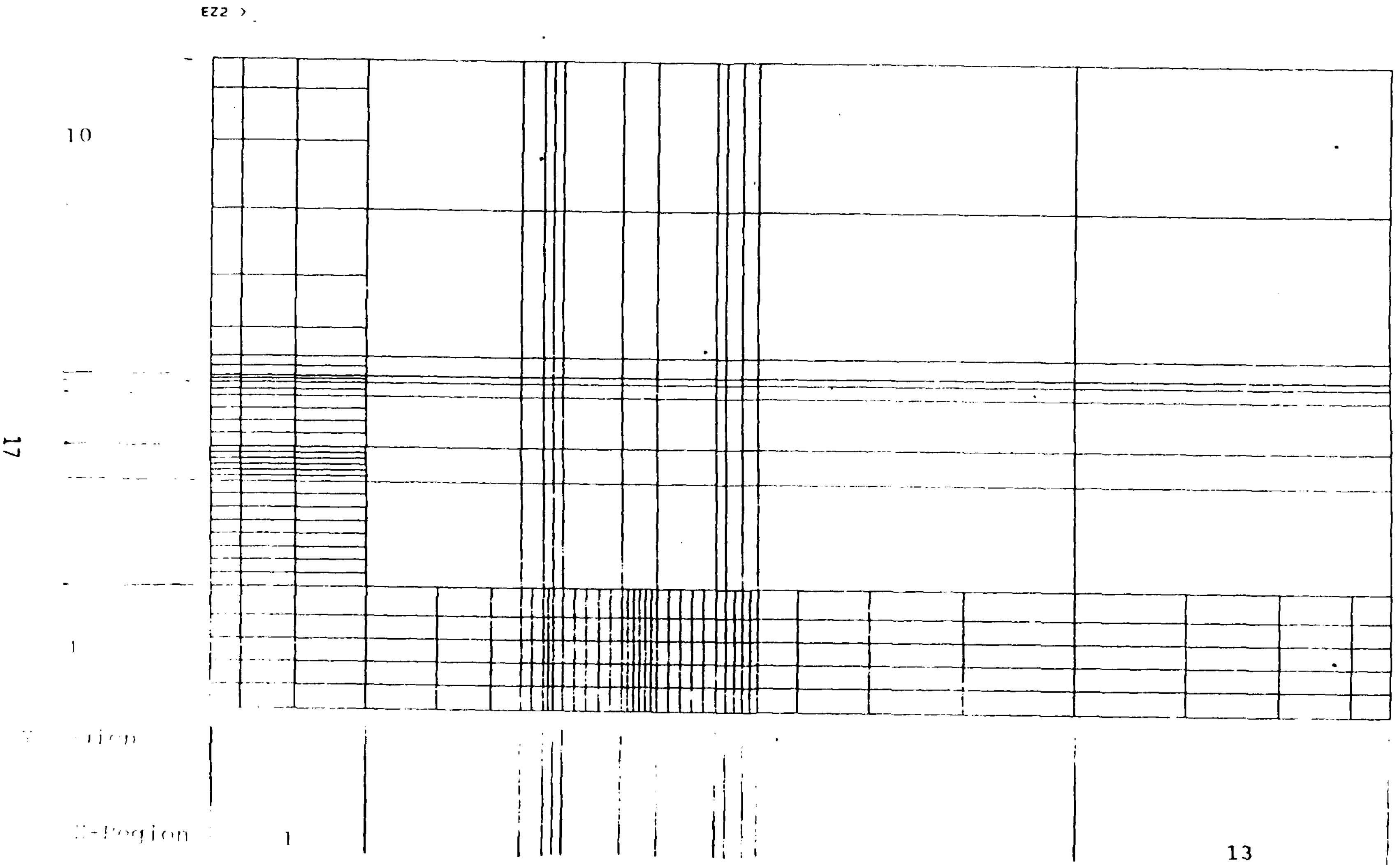


Figure 5. Regions of CS61

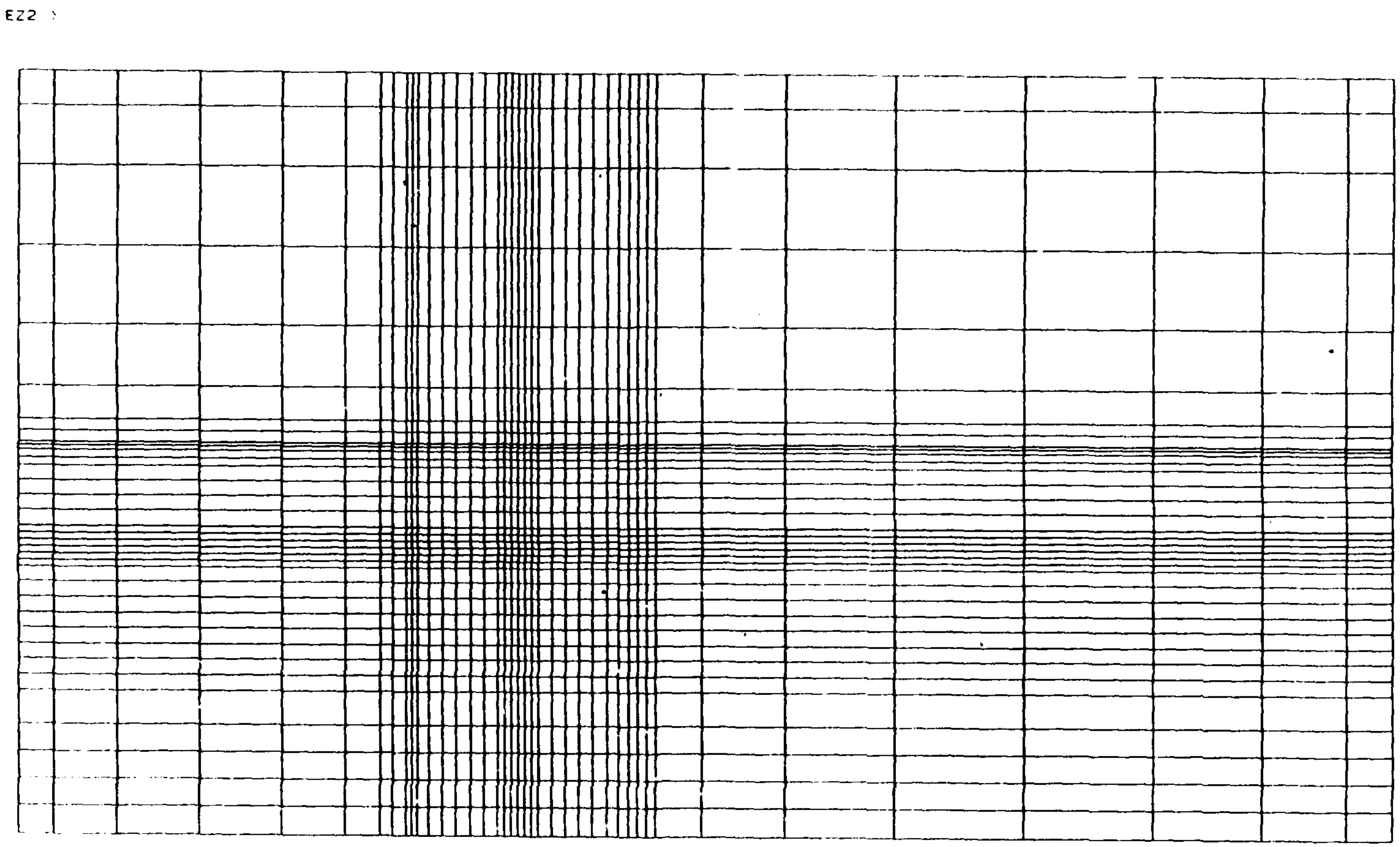


Figure 6. Grid of CS61

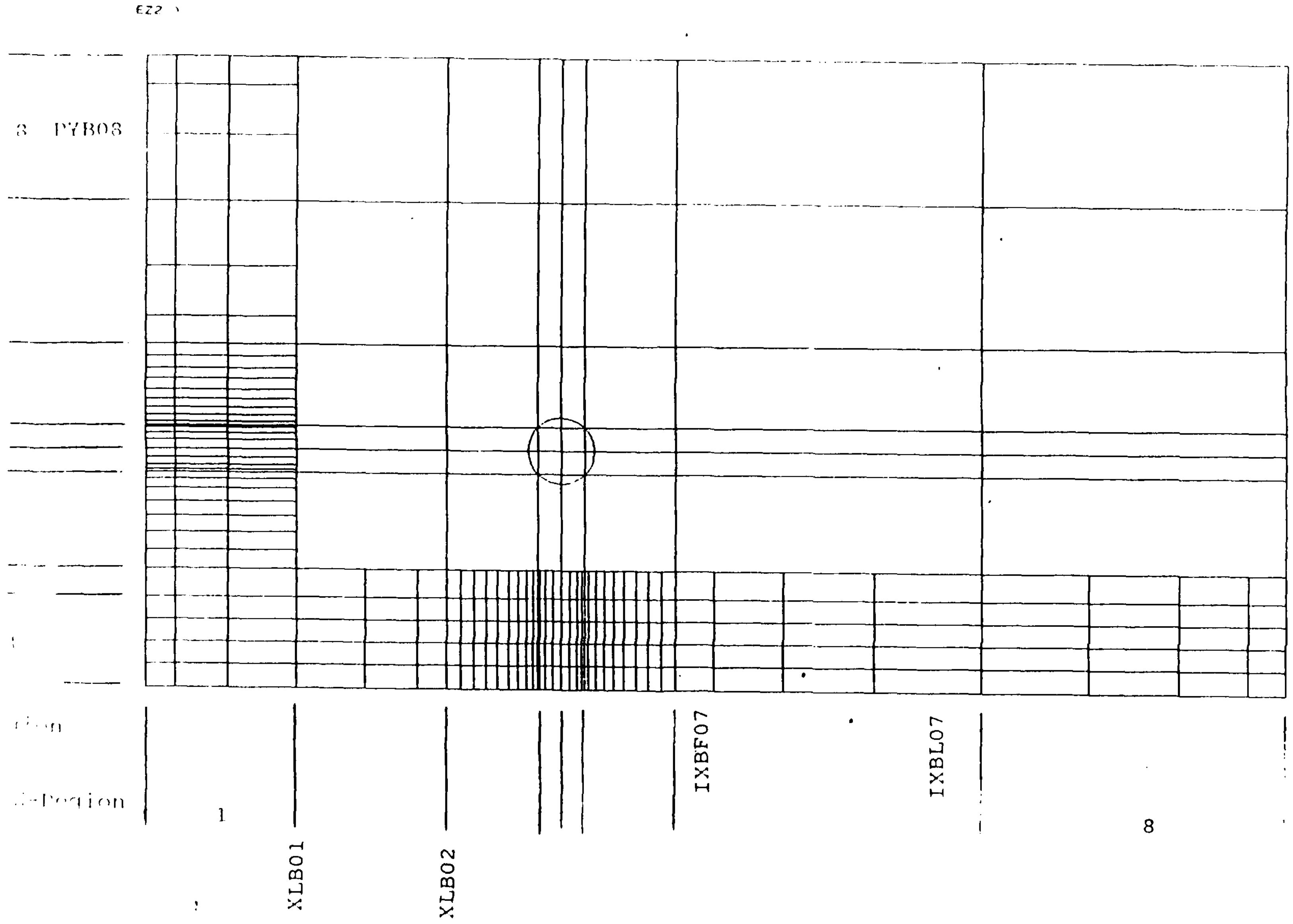


Figure 7. Regions of CS64

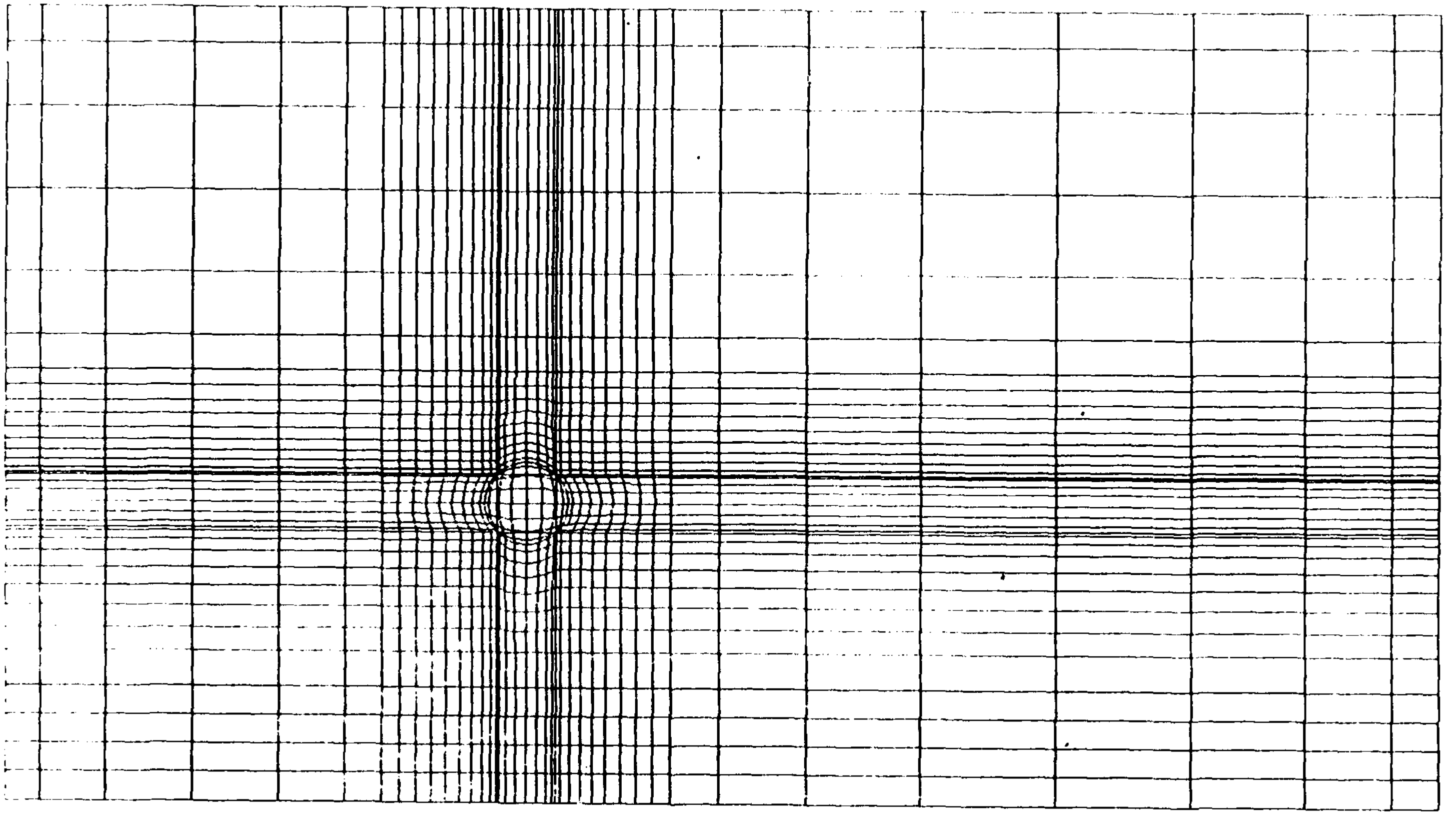


Figure 8. Initial Grid of CS64

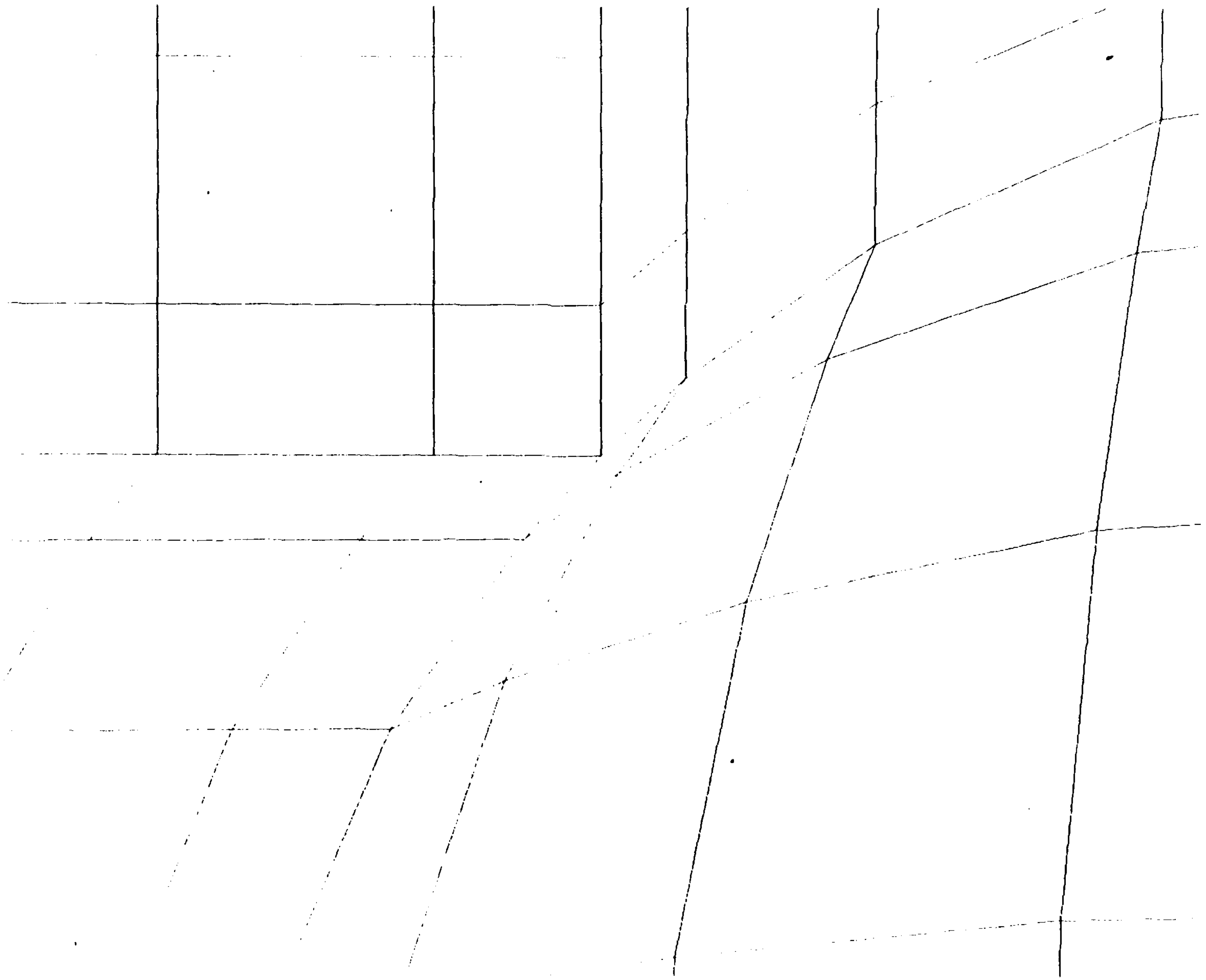


Figure 9. Enlargement of Initial Grid of CS64

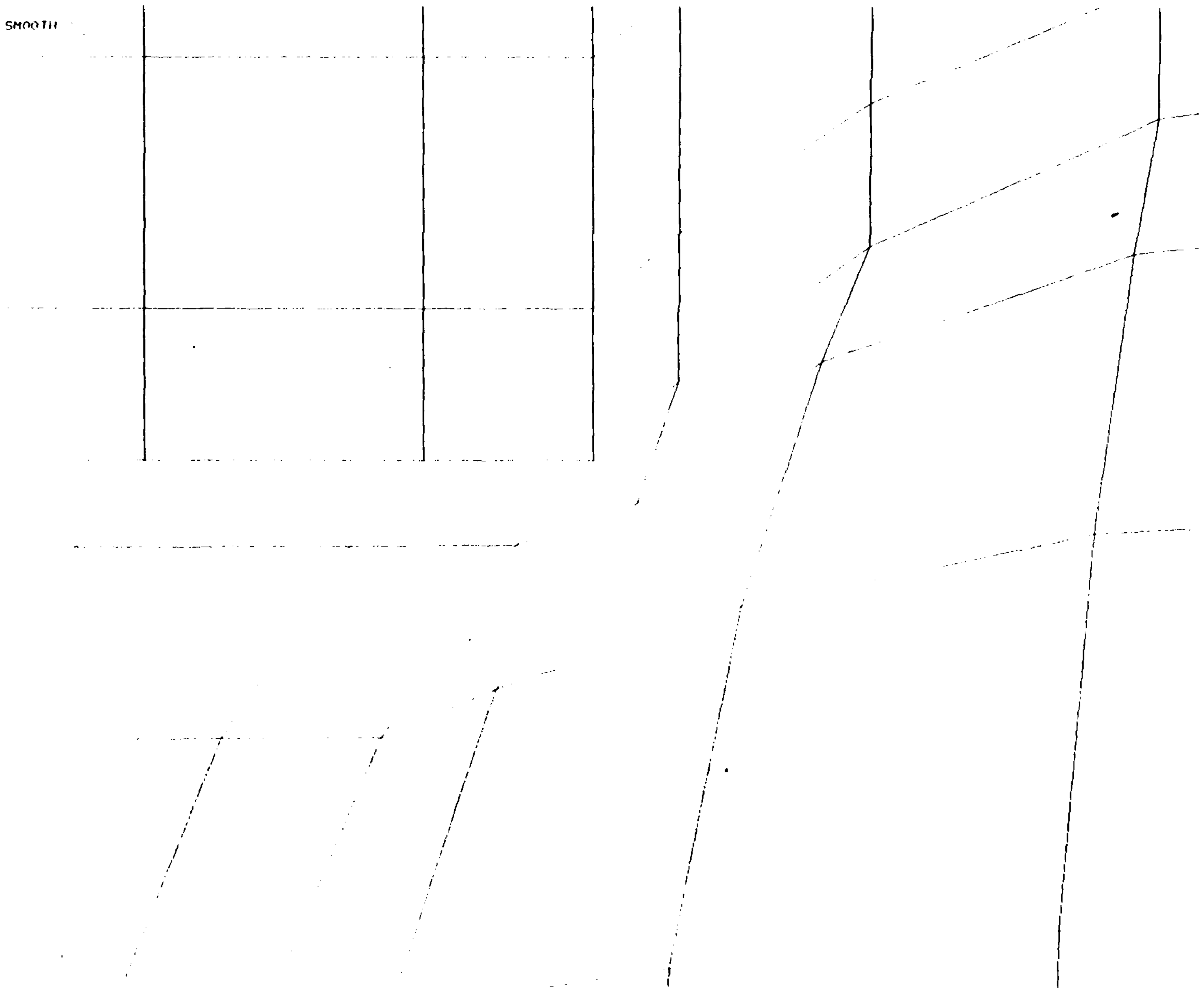


Figure 10. Enlargement of Final Grid of CS64

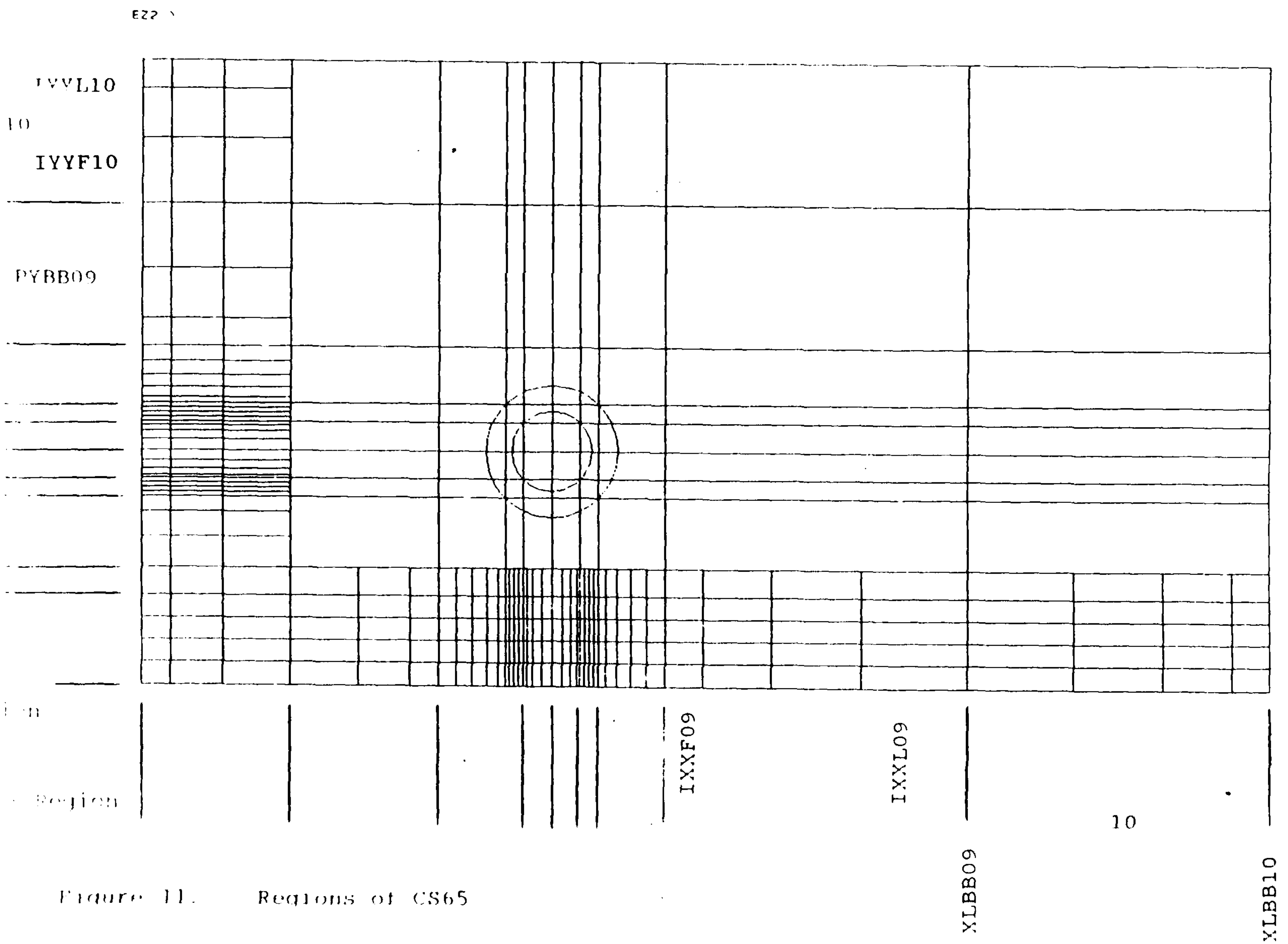


Figure 11.   Regions of CS65

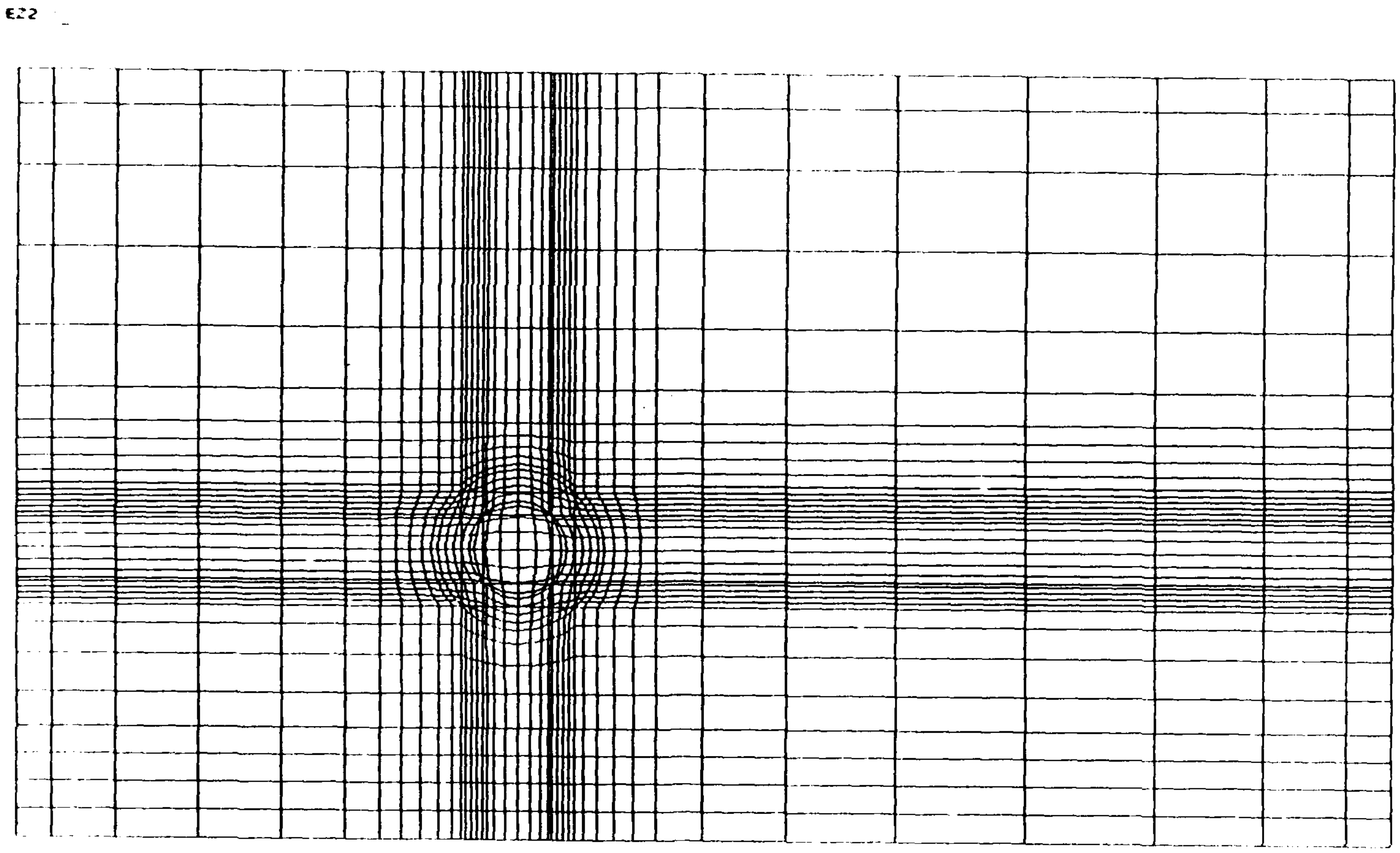


Figure 12. Initial Grid of CS65

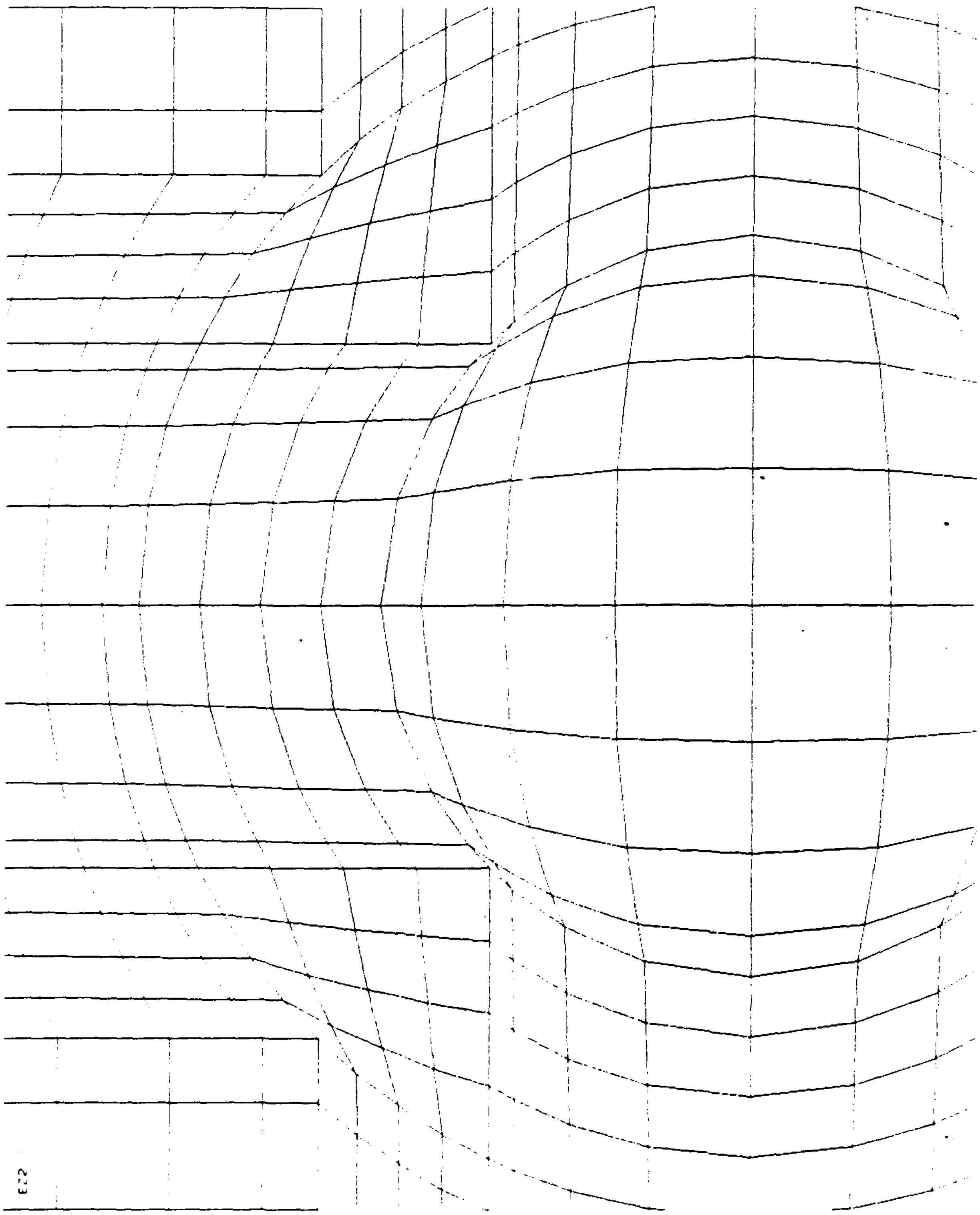


Figure 13. Enlargement of Initial Grid of CS65

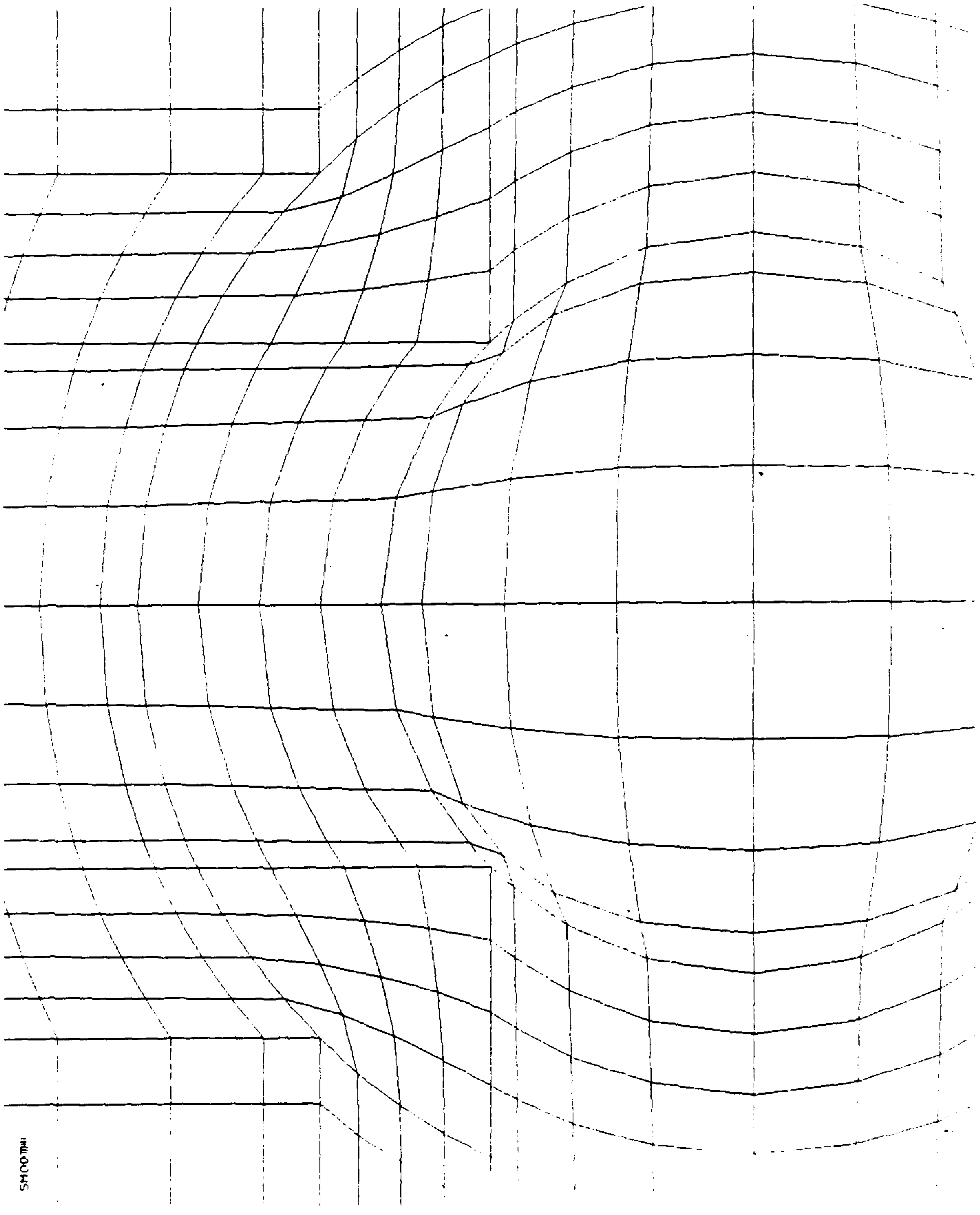


Figure 14. Enlargement of Final Grid of CS65

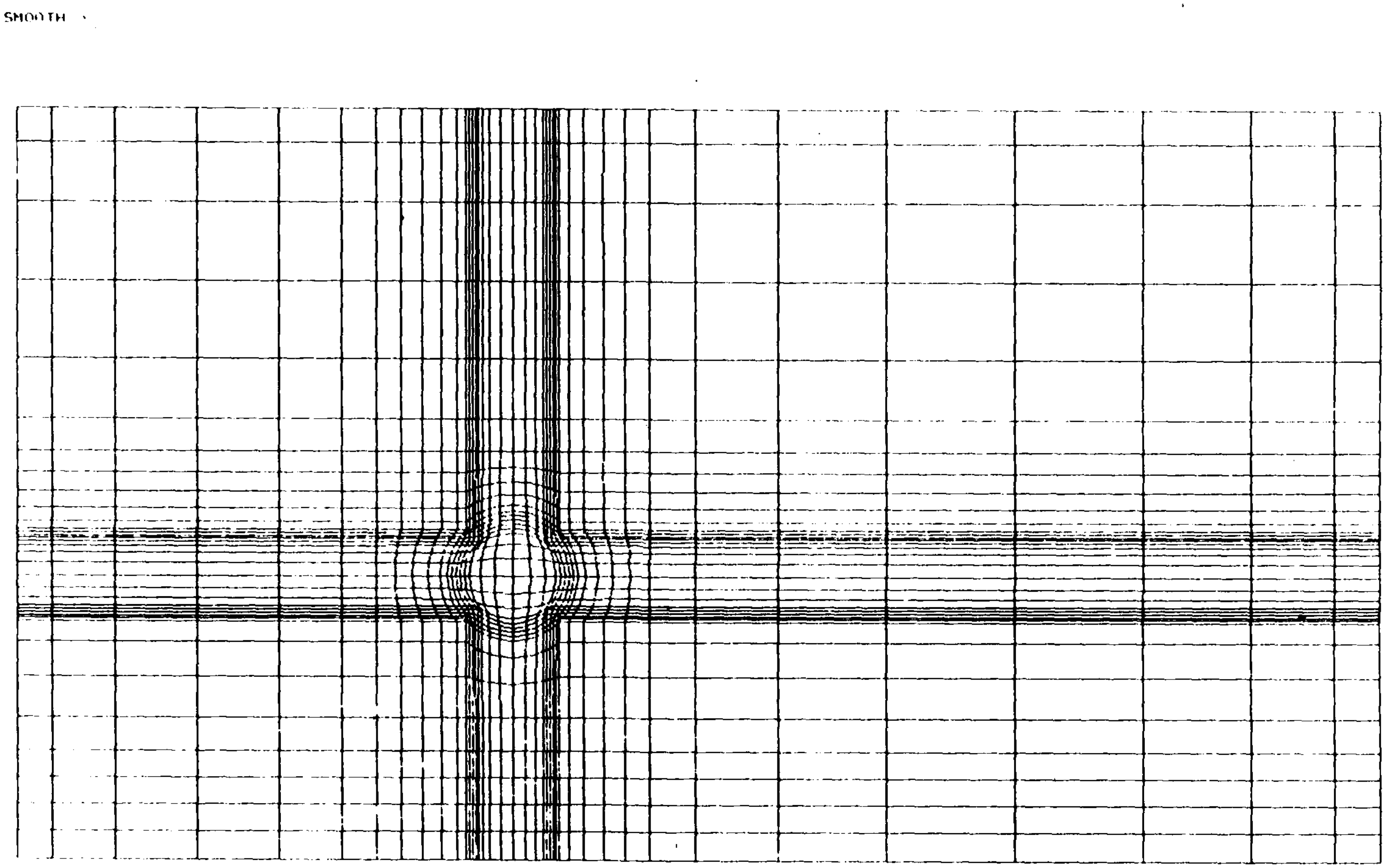


Figure 15. Final Grid of CS66

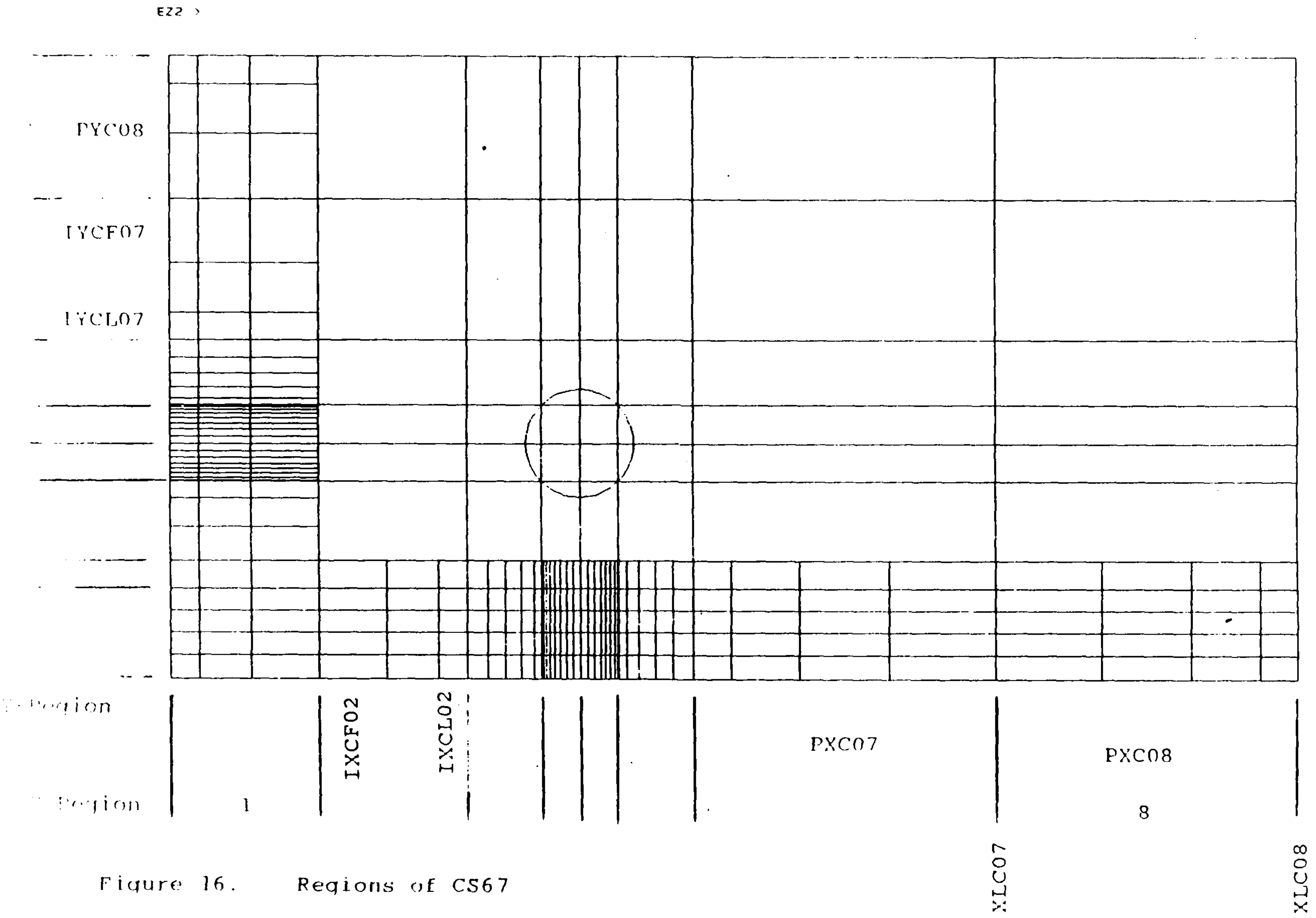


Figure 16.   Regions of CS67

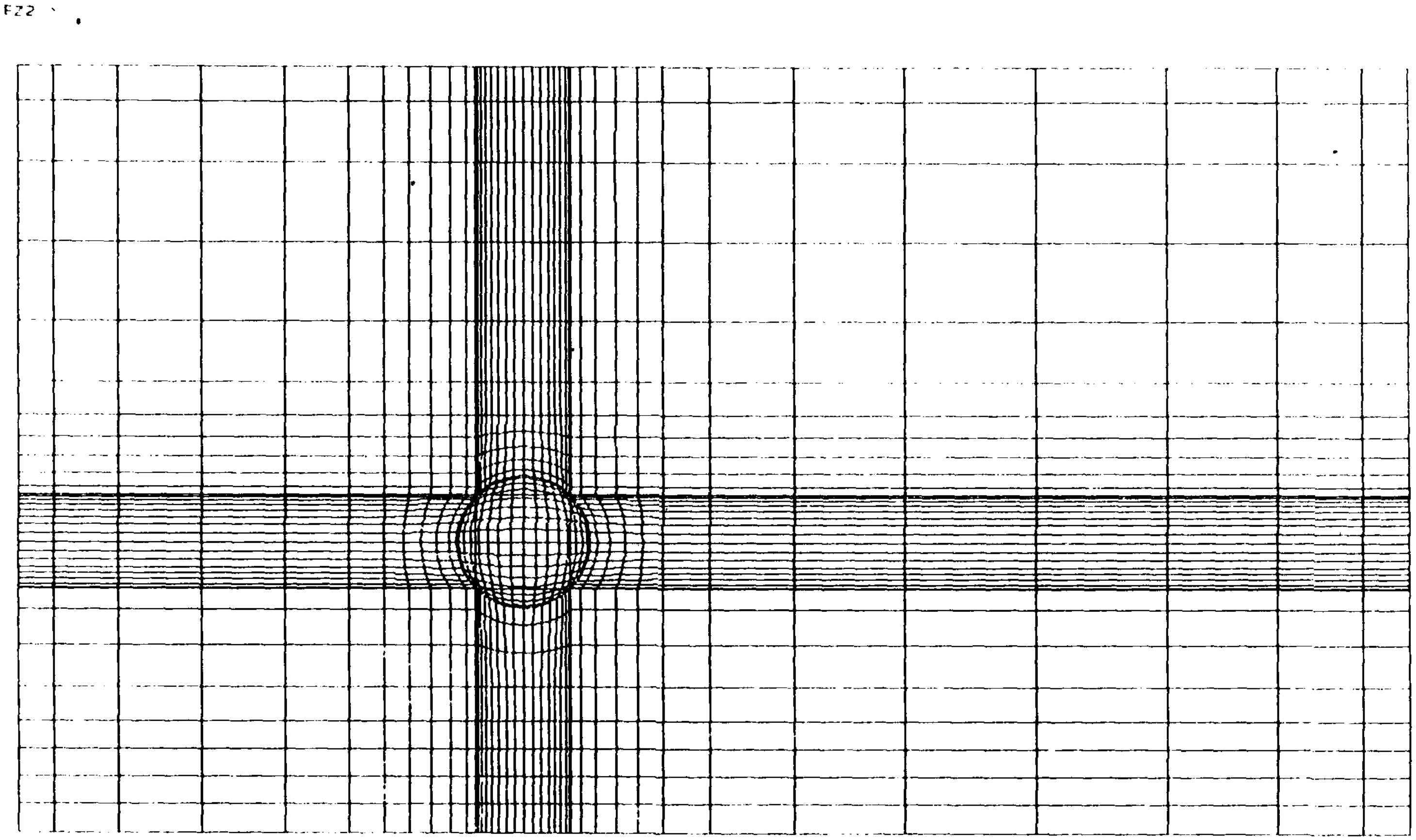


Figure 17. Initial Grid of CS67

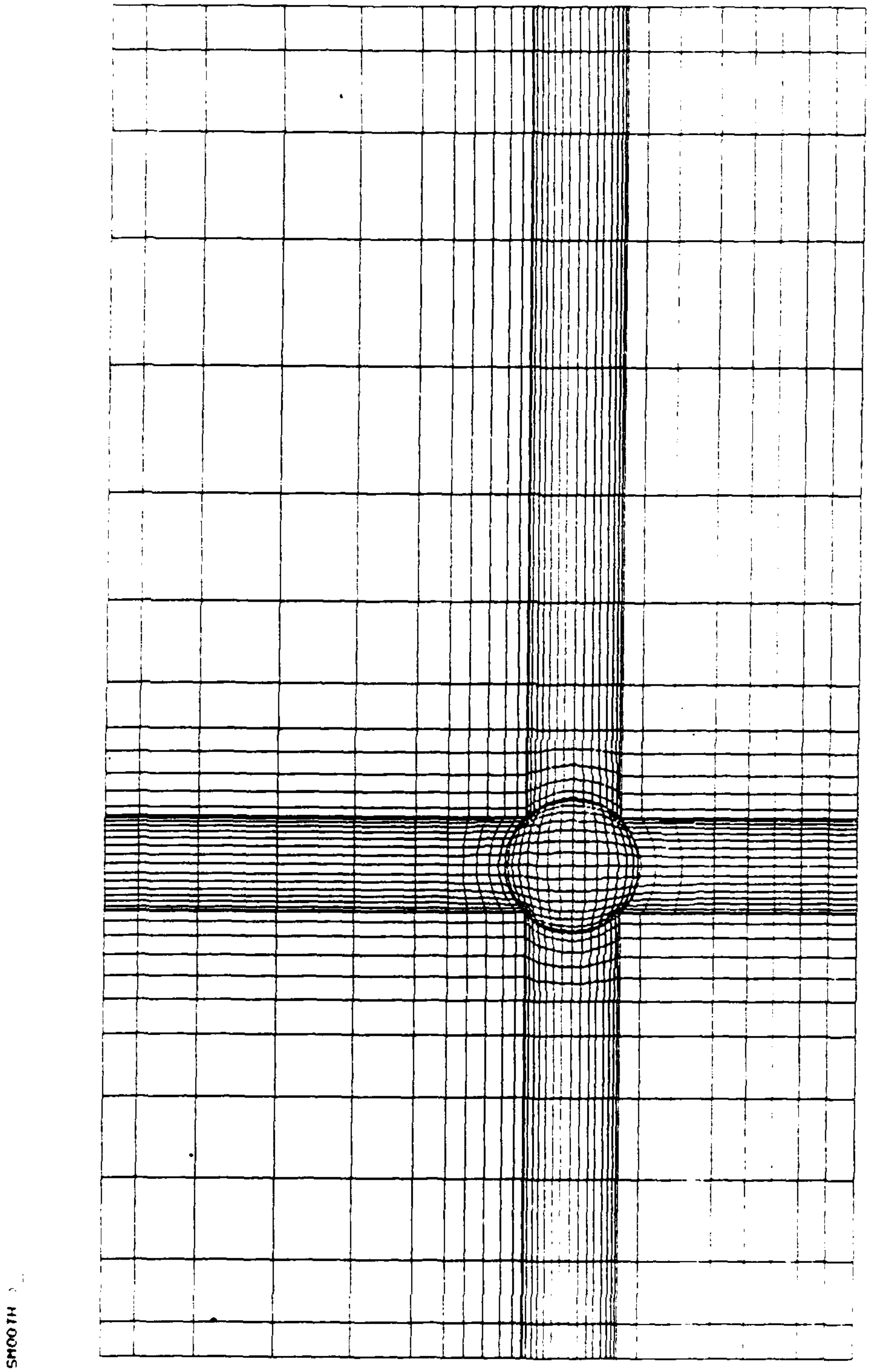


Figure 18. Final Grid of CS68

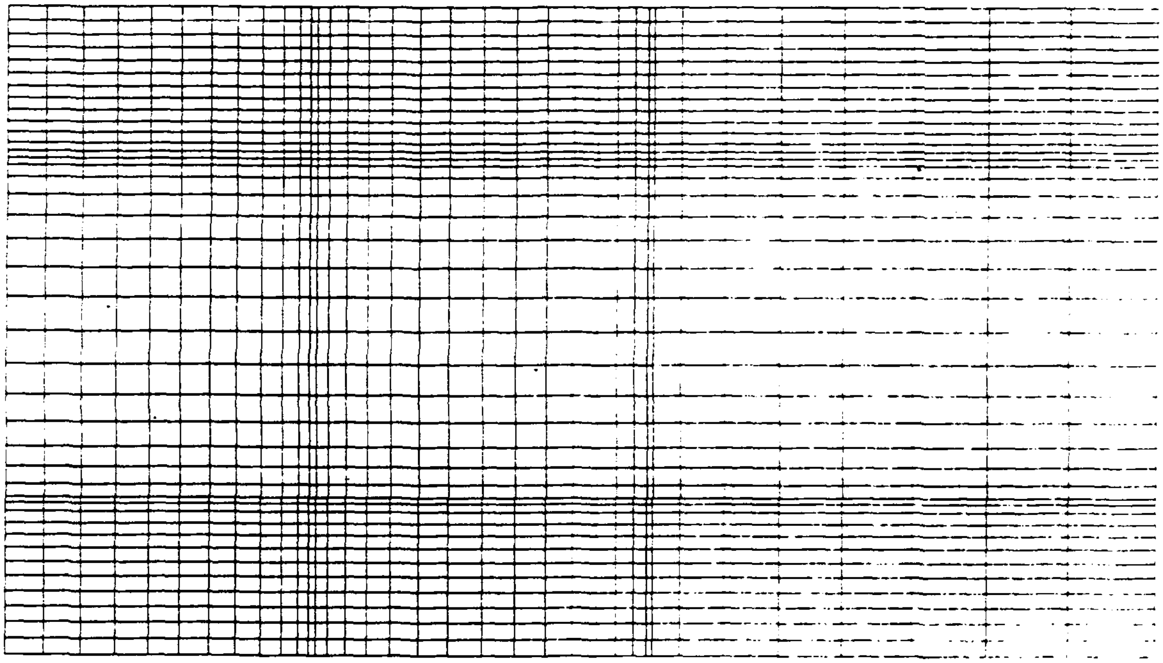


Figure 19. Grid of CS69

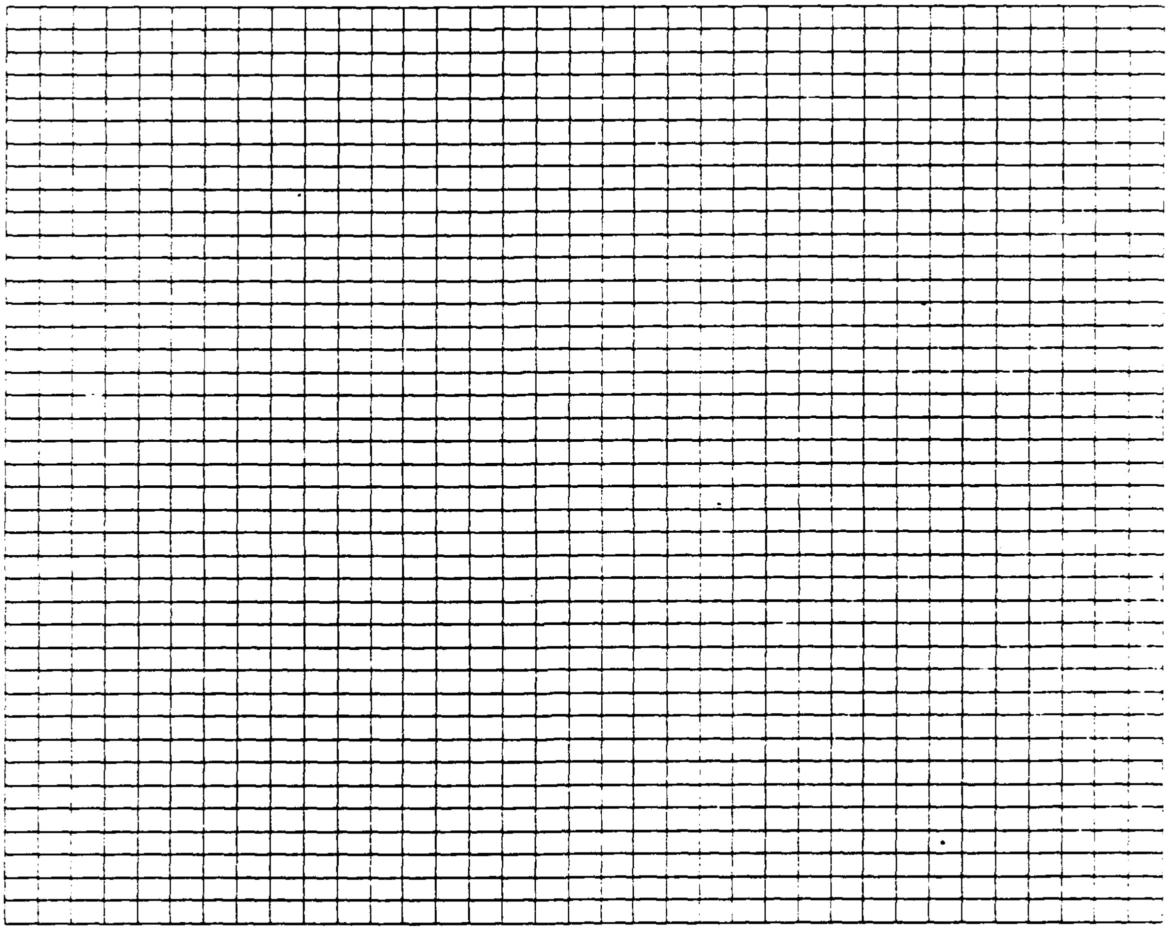
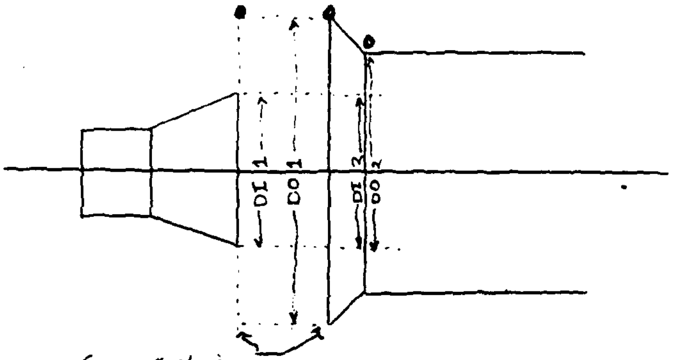


Figure 20. Grid of CS70

APPENDIX A

LOCATIONS OF DI_x + DO_x

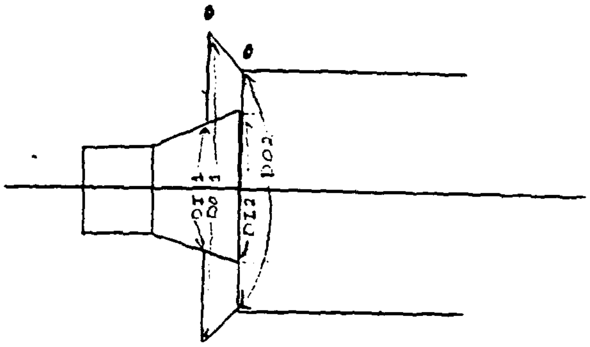
TYPE A



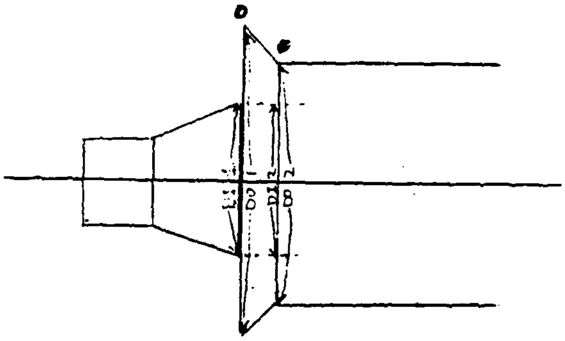
Same X-Y plane use in these 2 locations

• X-Y plane locations

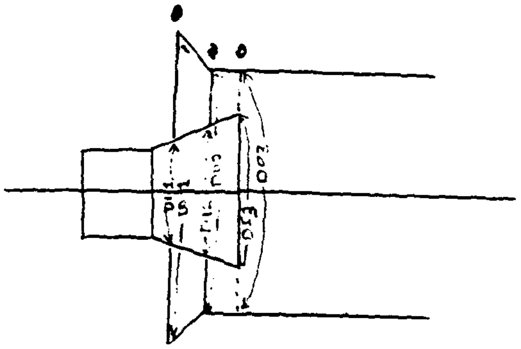
TYPE D



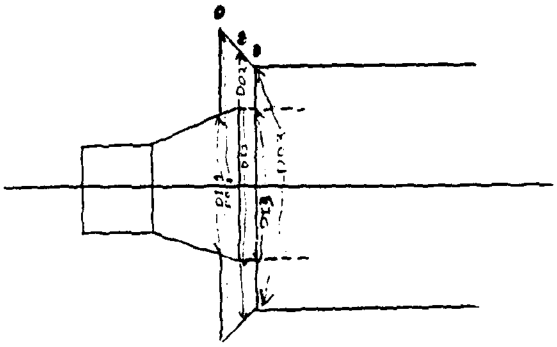
TYPE B



TYPE E



TYPE C



D → Diameter

I → Inner

O → Outer

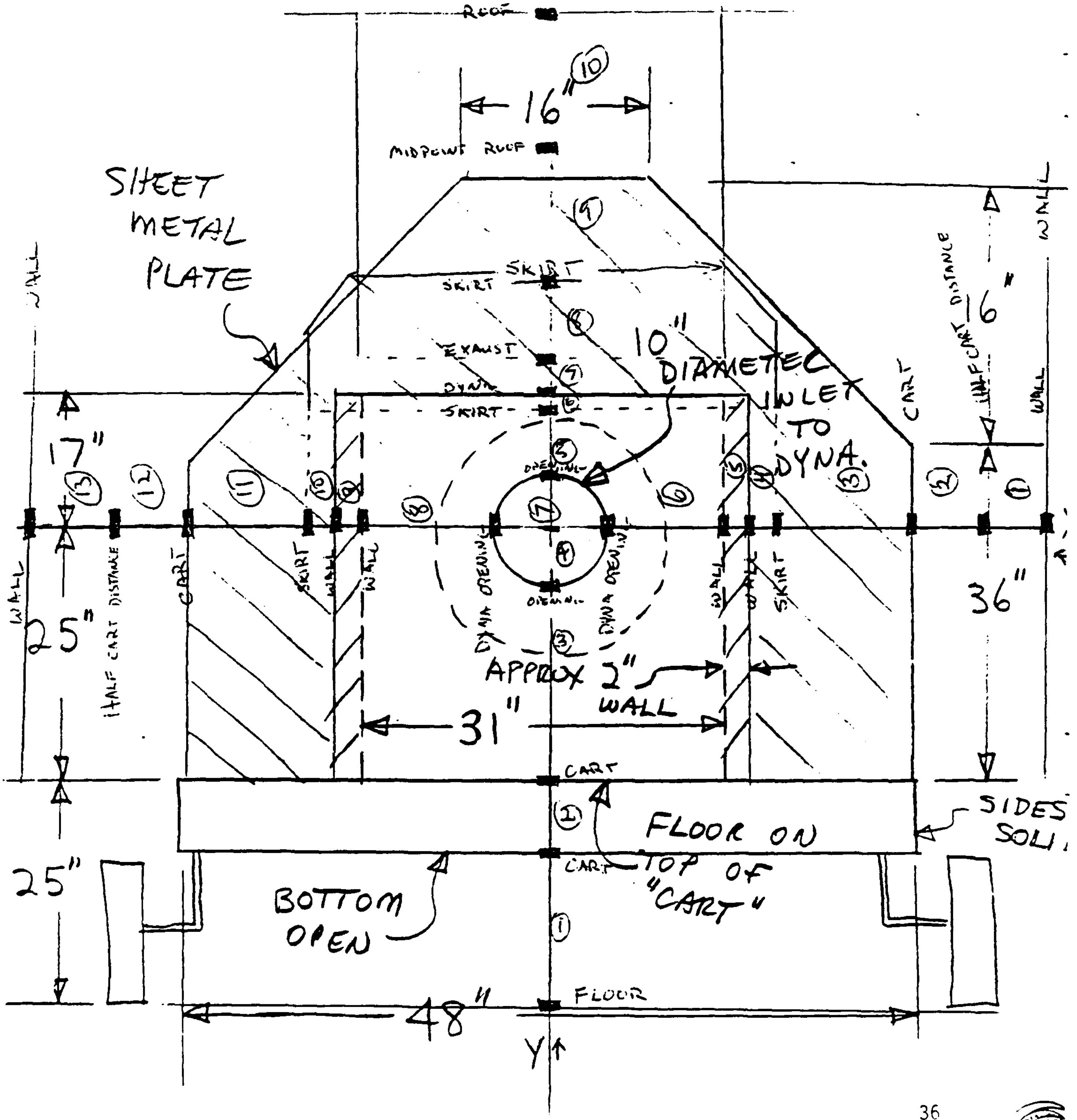
1 → Plane 1

2 → Plane 2

3 → Plane 3

LOCATION OF REGIONS FOR TYPE 1

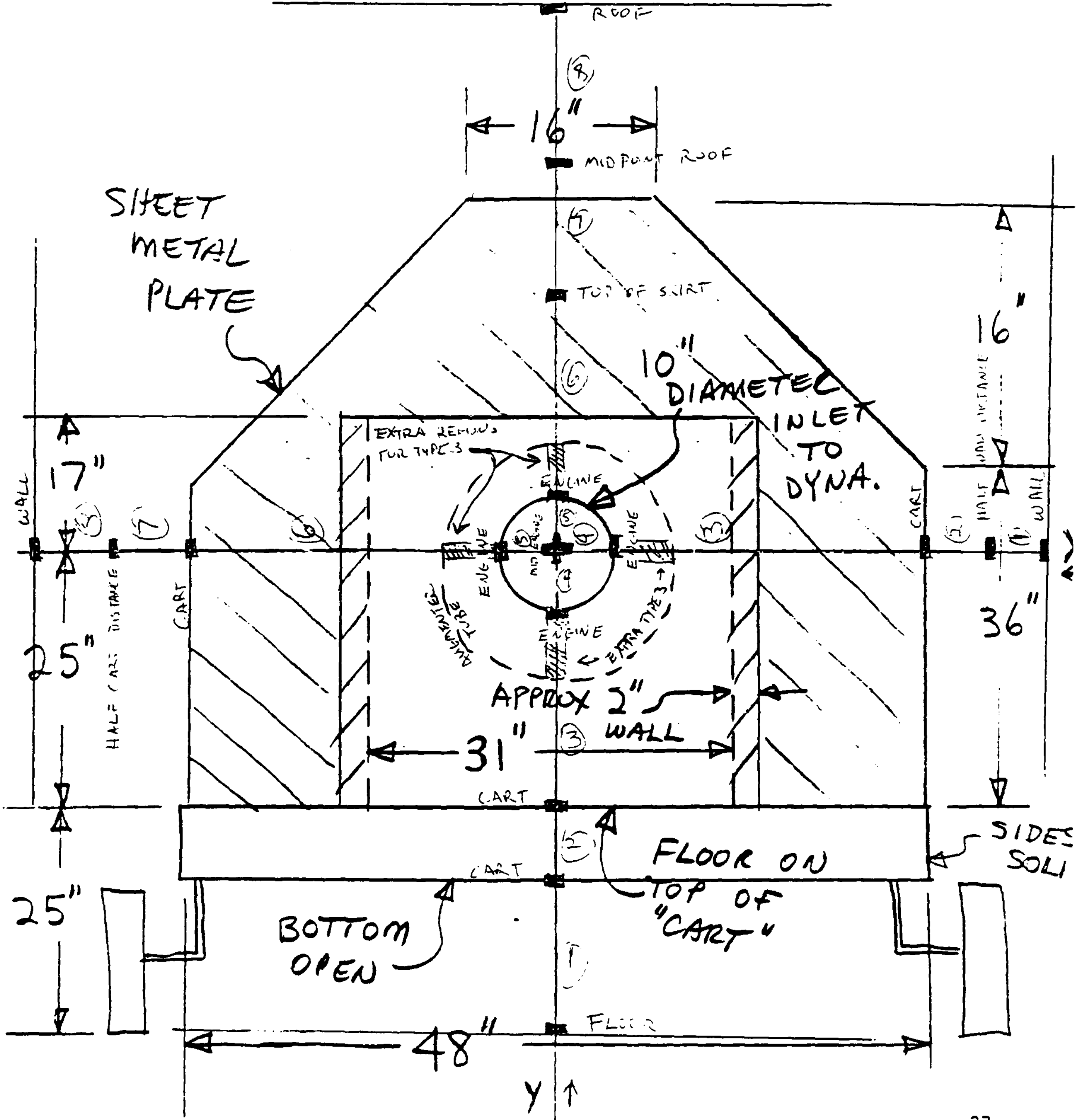
DYNAMOMETER FRONT
LOOKING REARWARD



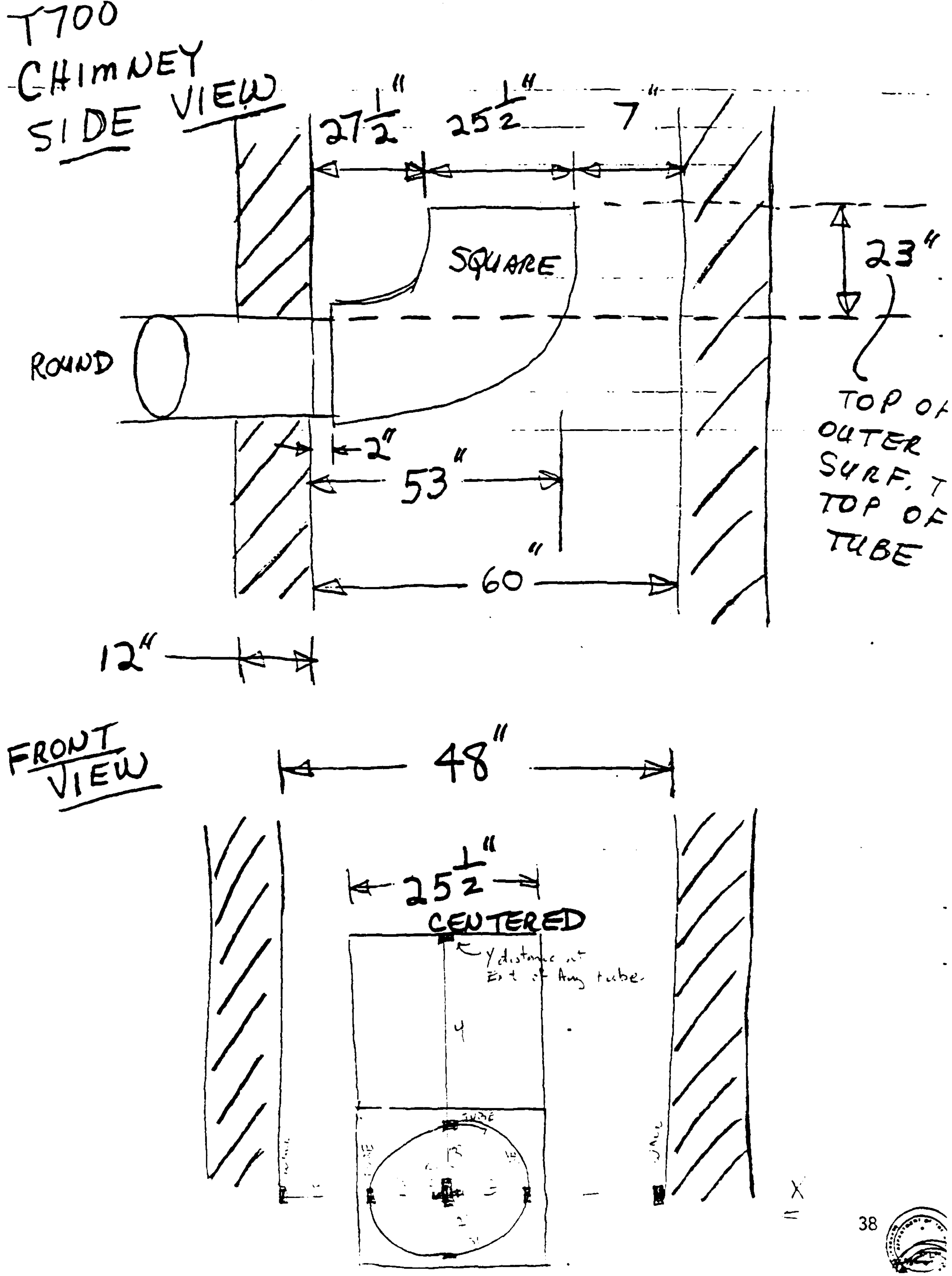
LOCATION OF REGIONS FOR TYPE 2 + 3 + 4

NOTE: THIS IS A CUT ACROSS THE ENGINE or/and AUGMENTER
NOTE. TYPE 3 CONTAINS 2 EXTRA REGIONS IN BOTH DIRECTIONS
NOTE: TYPE 4 IS LIKE TYPE 2 WITH POINTS ON THE AUGMENTER TUBE INSTEAD OF THE ENGINE

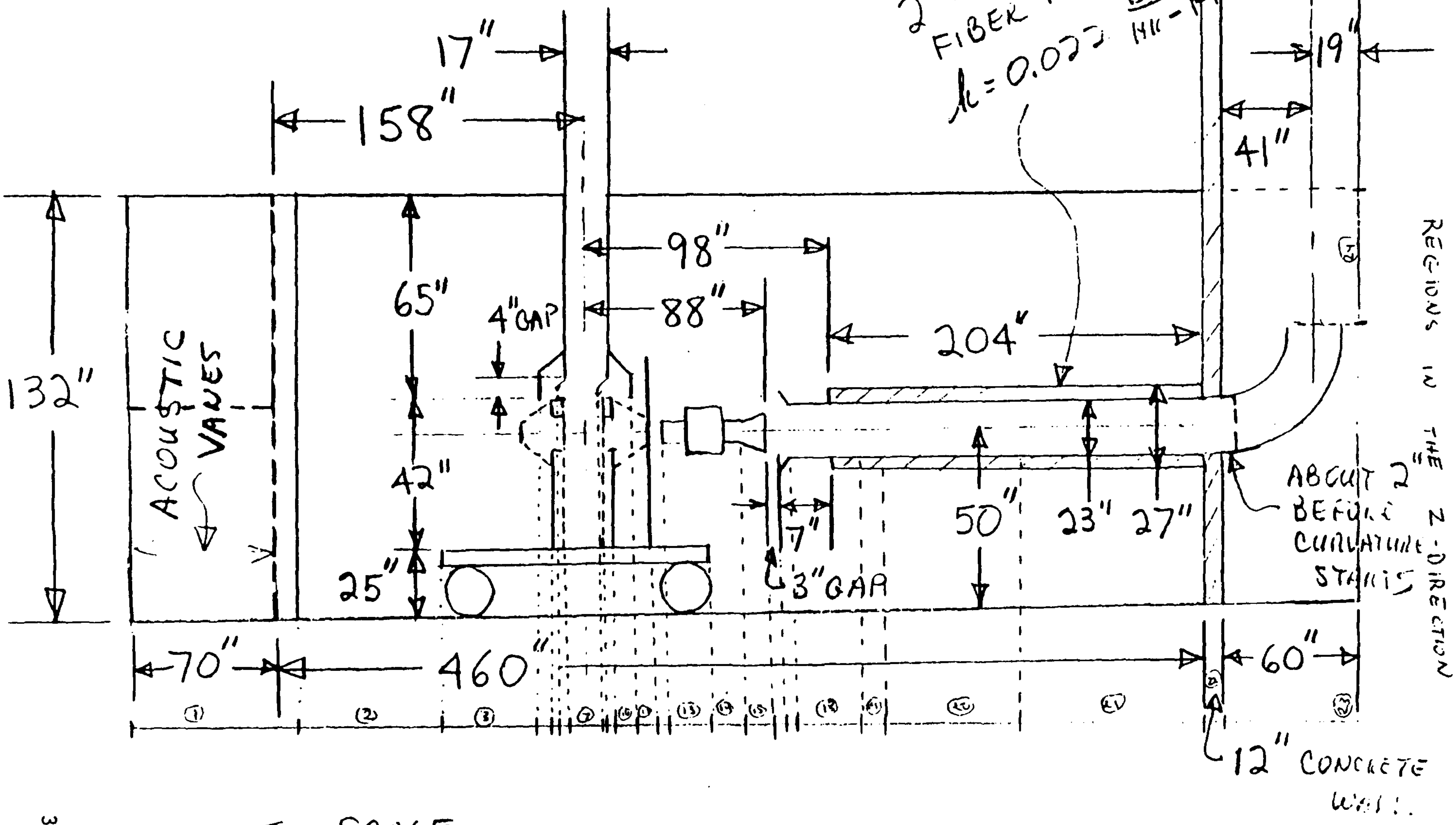
DYNAMOMETER FRONT LOOKING REARWARD



LOCATION OF REGIONS FOR TYPE 5



CAMP PENDLETON T700 TEST-CELL SIDE VIEW


2" MINERAL FIBER INSULATION
k = 0.022 BTU / HR-FT-°F/FT
17"
158"
19"
41"
132"
65"
98"
4" GAP
88"
204"
ACOUSTIC VANES
42"
25"
50"
23"
27"
7"
3" GAP
ABOUT 2" BEFORE CURVATURE STARTS
REGIONS IN THE Z-DIRECTION
70"
460"
60"
12" CONCRETE WALL
1
2
3
13
15
20
21

NOT TO SCALE
EVERYTHING IN INCHES

APPENDIX B

```
TALK=F;RUN(1,1)
    GROUP 1. Run title and other preliminaries
TEXT(NCEL:  TEST CELL--TURBOSHAFT ENGINE)
  *
  *********************************************************************
  *********                   GRID SECTION                    *********
  *********************************************************************
  ***   PRELIMINARY: Grid generation is an art form.  This          ***
  ***     model attempts to make this process as painless as        ***
  ***     possible.  Several assumptions will be made during        ***
  ***     this procedure.  Each will be stated at an appropriate    ***
  ***     time.  These assumptions may limit the parametric         ***
  ***     geometrical studies that can be accomplished.             ***
  ***     Geometric changes as called for by the contract will      ***
  ***     be possible and fairly easy to implement.  This method    ***
  ***     will not make it easy for radical modifications to be     ***
  ***     modeled.  However, with the appropriate assistance such   ***
  ***     changes should be possible.                               ***
  *********************************************************************
  *
  *
  *********************************************************************
  ***                                                               ***
  ***   PREMISE:  The grid for the test cell is created from a      ***
  ***     2-dimensional grid generation package.  This package      ***
  ***     produces several X-Y cross sections.  These sections      ***
  ***     are then stacked, blended, or rotated to produce the      ***
  ***     entire computational domain.  In order to do this, grid   ***
  ***     information data is supplied by the user in the Q1        ***
  ***     file.  This information is then transferred to SATLIT     ***
  ***     where the input files for the grid generation are         ***
  ***     created.  The user must then manually run the grid        ***
  ***     generation program to produce a plane of X-Y grid         ***
  ***     points for each input file.  After this the user will     ***
  ***     then rerun the preprocessor (Q1-SATLIT) at which time     ***
  ***     the full computational grid will be produced.  This       ***
  ***     current method is not fully automated, but it requires    ***
  ***     the user to examine each computational plane, which can   ***
  ***     reduce grid errors.                                       ***
  ***                                                               ***
  *********************************************************************
  *
  *
  *********************************************************************
  ***                                                               ***
  ***   DESCRIPTION OF PLANES:  In its present form the SATLIT      ***
  ***     will write out 5 or 6 types of X-Y planes depending on    ***
  ***     whether a circle in circle grid is created (ie. if        ***
  ***     nozzle is close to augmenter tube).  Out of these         ***
  ***     various types of planes, modifications of these types     ***
  ***     are created (ie. the augmenter tube diameter changes).    ***
  ***     For the case that is delivered, 10 planes of grids are    ***
  ***     created.  A description of each plane is now provided.    ***
  ***                                                               ***
  ***   TYPE 1  --  Indicated by letter A.  This type is used       ***
  ***     for the dynamometer.  There are three planes created      ***
  ***     under this type.  The first is located at the             ***
  ***     entrance.  One vertical line has been shifted to          ***
  ***     correspond to location of the inlet.  The second is       ***
  ***     a cross section of the dynamometer with the circle        ***
***     being a square.  The third is a cross section of the      ***
***     dynamometer.                                               ***
***                                                                ***
***   TYPE 2  --  Indicated by letter B.  This type is used        ***
***     for the engine.  It creates two planes of grids, one       ***
***     for the engine inlet and one for the nozzle exit.  If      ***
***     TYPE 3 is used it only creates the plane at the inlet.     ***
***                                                                ***
***   TYPE 3  --  Indicated by letter BB.  This type is used       ***
***     only if a circle in circle grid is created.  A circle      ***
***     in circle grid refers to a grid type in the X-Y plane      ***
***     that contains a circle shape in side a circle shape.       ***
***     In this case, the inner circle will represent a cross      ***
***     of the engine while the outer circle will represent a      ***
***     cross section of the augmenter tube.  If the exit of       ***
***     the nozzle is too close to the augmenter tube this         ***
***     option will give better orthogonality.  This type will     ***
***     produce two or three planes.  If the nozzle ends before    ***
***     or at the augmenter lip or at the start of the constant    ***
***     cross section of the augmenter sleeve, two planes are      ***
***     created.  The first is for the exit of the nozzle and      ***
***     the start of the lip and the second is for the start       ***
***     of the constant cross section of the sleeve.  If the       ***
***     nozzle ends in the tappered (lip) section or in the        ***
***     straight section of the sleeve one additional plane        ***
***     will be needed for where the nozzle ends.                  ***
***                                                                ***
***   TYPE 4  --  Indicated by letter C.  This type is used        ***
***     to create the augmenter tube in the building.  At the      ***
***     present time this type produces two planes.  One that      ***
***     corresponds to the diameter of the sleeve and one to       ***
***     represent the diameter of the augmenter tube.  If          ***
***     TYPE 3 is not used, the first plane is at the augmenter    ***
***     lip.                                                       ***
***                                                                ***
***   TYPE 5  --  Indicated by letter D.  This type is used        ***
***     to create the augmenter tube at the front wall of the      ***
***     chimney.  The augmenter tube can either be a circle or     ***
***     a square.  ASSUMPTION:  It is assumed the center of        ***
***     curvature starts at the back wall.  ASSUMPTION:  If a      ***
***     square tube is used in the chimney, the circle to a        ***
***     square will be blended through the back wall of the        ***
***     building.                                                  ***
***                                                                ***
***   TYPE 6  --  Data needed for this plane is taken from the     ***
***     other types.  This type creates the exit plane (top of     ***
***     chimney).                                                  ***
***                                                                ***
***   At this time each variable used in the description of        ***
***   griding in the X-direction (horizontal) will be provided.    ***
***   The (0,0,0) coordinate is located (standing in front of      ***
***   building) at the lower right hand corner.  Parameters        ***
***   are used extensively throughout this program to make         ***
***   changes easier.                                              ***
***                                                                ***
*******************************************************************
*
*
*******************************************************************
*********               X-DIRECTION GRIDING               *********
```

```
**********************************************************************
***                                                                ***
***   NRXA    --  Number of X regions for Type 1 plane             ***
***   NRXB    --  Number of X regions for Type 2 plane             ***
***   NRXBB   --  Number of X regions for Type 3 plane             ***
***   NRXC    --  Number of X regions for Type 4 plane             ***
***   NRXD    --  Number of X regions for Type 5 plane             ***
***                                                                ***
***   NOTE:  The number of grid cells is define for the Type 1     ***
***          plane and then redistributed for the other types.     ***
***          There are fourteen available regions, some may        ***
***          not be used.                                          ***
***                                                                ***
***   NX01    --  Number of cells in 1st region -> Wall to         ***
***               half distance cart                               ***
***   NX02    --  Number of cells in 2nd region -> Half            ***
***               distance cart to cart                            ***
***   NX03    --  Number of cells in 3rd region -> Cart to         ***
***               skirt                                            ***
***   NX04    --  Number of cells in 4th region -> Skirt to        ***
***               dynamometer wall                                 ***
***   NX05    --  Number of cells in 5th region -> Dynamometer     ***
***               wall to dynamometer wall                         ***
***   NX06    --  Number of cells in 6th region -> Dynamometer     ***
***               wall to dynamometer opening                      ***
***   NX07    --  Number of cells in 7th region -> Dynamometer     ***
***               opening to dynamometer opening                   ***
***   NX08    --  Number of cells in 8th region -> Dynamometer     ***
***               opening to dynamometer wall                      ***
***   NX09    --  Number of cells in 9th region -> Dynamometer     ***
***               wall to dynamometer wall                         ***
***   NX10    --  Number of cells in 10th region -> Dynamometer    ***
***               wall to skirt                                    ***
***   NX11    --  Number of cells in 11th region -> Skirt to       ***
***               cart                                             ***
***   NX12    --  Number of cells in 12th region -> Cart to        ***
***               half distance cart                               ***
***   NX13    --  Number of cells in 13th region -> Half           ***
***               distance cart to wall                            ***
***   NX14    --  Number of cells in 14th region -> Spare          ***
***                                                                ***
***   NOTE:  The regions for the other 5 Types will now also       ***
***          be defined.                                           ***
***   TYPE 2                                                       ***
***     Region 1  --  Wall to half distance cart                   ***
***     Region 2  --  Half distance cart to cart                   ***
***     Region 3  --  Cart to engine                               ***
***     Region 4  --  Engine to midpoint engine                    ***
***     Region 5  --  Midpoint engine to engine                    ***
***     Region 6  --  Engine to cart                               ***
***     Region 7  --  Cart to half distance cart                   ***
***     Region 8  --  Half distance cart to wall                   ***
***   TYPE 3                                                       ***
***     Region 1  --  Wall to half distance cart                   ***
***     Region 2  --  Half distance cart to cart                   ***
***     Region 3  --  Cart to augmenter tube                       ***
***     Region 4  --  Augmenter tube to engine                     ***
***     Region 5  --  Engine to midpoint engine                    ***
***     Region 6  --  Midpoint engine to engine                    ***
***     Region 7  --  Engine to augmenter tube                     ***
***     Region 8  --  Augmenter tube to cart                    ***
***     Region 9  --  Cart to half distance cart                ***
***     Region 10 --  Half distance cart to wall                ***
***   TYPE 4                                                    ***
***     Region 1  --  Wall to half distance cart                ***
***     Region 2  --  Half distance cart to cart                ***
***     Region 3  --  Cart to augmenter tube                    ***
***     Region 4  --  Augmenter tube to midpoint aug tube       ***
***     Region 5  --  Midpoint augmenter tube to aug tube       ***
***     Region 6  --  Augmenter tube to cart                    ***
***     Region 7  --  Cart to half distance cart                ***
***     Region 8  --  Half distance cart to wall                ***
***   TYPE 5                                                    ***
***     Region 1  --  Wall to augmenter tube                    ***
***     Region 2  --  Augmenter tube to midpoint aug tube       ***
***     Region 3  --  Midpoint augmenter tube to aug tube       ***
***     Region 4  --  Augmenter tube to wall                    ***
***   TYPE 6                                                    ***
***     Region 1  --  Wall to wall                              ***
***                                                             ***
***   NXAD     --  Number of cells in X-direction picked up by  ***
***                the engine                                   ***
***   NXBD     --  Number of cells in X-direction picked up by  ***
***                the augmenter tube                           ***
***   NOTE:  This last two items have corresponding parameters  ***
***          for the Y-direction.  Generally their valves will  ***
***          be equal.                                          ***
***                                                             ***
***   IXAF**   --  First cell number of ** region Type 1        ***
***   IXAL**   --  Last cell number of ** region Type 1         ***
***   IXBF**   --  First cell number of ** region Type 2        ***
***   IXBL**   --  Last cell number of ** region Type 2         ***
***   IXXF**   --  First cell number of ** region Type 3        ***
***   IXXL**   --  Last cell number of ** region Type 3         ***
***   IXCF**   --  First cell number of ** region Type 4        ***
***   IXCL**   --  Last cell number of ** region Type 4         ***
***   IXDF**   --  First cell number of ** region Type 5        ***
***   IXDL**   --  Last cell number of ** region Type 5         ***
***                                                             ***
***   IXMON*   --  Location of * monitoring point (9 extra).    ***
***                                                             ***
***   XLA**    --  Length to end of ** region Type 1 (in)       ***
***   XLB**    --  Length to end of ** region Type 2 (in)       ***
***   XLBB**   --  Length to end of ** region Type 3 (in)       ***
***   XLC**    --  Length to end of ** region Type 4 (in)       ***
***   XLD**    --  Length to end of ** region Type 5 (in)       ***
***                                                             ***
***   PXA**    --  Clustering factor of ** region Type 1        ***
***   PXB**    --  Clustering factor of ** region Type 2        ***
***   PXBB**   --  Clustering factor of ** region Type 3        ***
***   PXC**    --  Clustering factor of ** region Type 4        ***
***   PXD**    --  Clustering factor of ** region Type 5        ***
***   NOTE:  Clustering factor is a number used to shift the    ***
***          cell spacing in one direction.  This direction is  ***
***          controlled by setting this value to either a       ***
***          positive or negative value.  The default (uniform  ***
***          spacing) is 1.0.  This value may be less than or   ***
***          greater than 1.0.                                  ***
***                                                             ***
***   NOTE:  Some Y-info defined here                           ***
***   XCENA    --  Location in the X-direction of the center of   ***
***                the dynamometer hole (in)                      ***
***   YCENA    --  Location in the Y-direction of the center of   ***
***                the dynamometer hole (in)                      ***
***   XCENB    --  Location in the X-direction of the center of   ***
***                the engine (in)                                ***
***   YCENB    --  Location in the Y-direction of the center of   ***
***                the engine (in)                                ***
***   XCENC    --  Location in the X-direction of the center of   ***
***                the augmenter tube in room (in)                ***
***   YCENC    --  Location in the Y-direction of the center of   ***
***                the augmenter tube in room (in)                ***
***   XCEND    --  Location in the X-direction of the center of   ***
***                the augmenter tube in chimney (in)             ***
***   YCEND    --  Location in the Y-direction of the center of   ***
***                the augmenter tube in chimney (in)             ***
***                                                               ***
***   DDYNA    --  Diameter of dynamometer hole (in)              ***
***   DENGI    --  Diameter of engine opening (in)                ***
***   DENGO    --  Diameter of engine exit (in)                   ***
***   DAUGL    --  Diameter of augmenter sleeve lip (in)          ***
***   DAUGS    --  Diameter of augmenter sleeve (in)              ***
***   DAUGT    --  Diameter of augmenter tube in room (in)        ***
***   DAUGC    --  Diameter of augmenter tube in chimney (in)     ***
***                                                               ***
***   NOTE:    The following input is for the circle in circle    ***
***            grid.  The number of planes produced (either 2 or  ***
***            3) is controlled by the setting of IG(60).         ***
***            IG, RG, & LG are built in arrays that allow for    ***
***            easy transfer of integers, reals, and logicals to  ***
***            the various modules of the code.  See report for   ***
***            drawings detailing these various diameters.        ***
***   DI1      --  Diameter inner circle at first X-Y plane (in)  ***
***   DI2      --  Diameter inner circle at second X-Y plane (in) ***
***   DI3      --  Diameter inner circle at third X-Y plane (in)  ***
***   DO1      --  Diameter outer circle at first X-Y plane (in)  ***
***   DO2      --  Diameter outer circle at second X-Y plane (in) ***
***   DO3      --  Diameter outer circle at third X-Y plane (in)  ***
***                                                               ***
***   XINL     --  Length in X-direction of front inlet opening   ***
***                (in)                                           ***
***                                                               ***
***   PI       --  PI                                             ***
***   DYNAW    --  X-direction width of dynamometer               ***
***                                                               ***
*********************************************************************
*
*
*********************************************************************
***                                                               ***
***   LOGICALS:  There are 4 logical flags in the Q1 file.        ***
***              These are outlined below.                        ***
***                                                               ***
***   LG(1)  --  T if the dynamometer exhaust has a skirt         ***
***   LG(2)  --  T if a circle in circle grid is used (TYPE 3)    ***
***   LG(3)  --  T if augmenter tube in chimney is square         ***
***   LG(4)  --  T if the inlet baffles extend into room          ***
***                                                               ***
***   WARNING:  Certain lines of coding have to be activated      ***
***             or deactivated for certain logicals.  Search      ***
```

```
  ***             for the string &&&LG&&& to locate such coding.    ***
  ***             Active coding starts in the first two columns.    ***
  ***   NOTE:  There is certain coding that is needed for           ***
  ***          specific grid types.  It will be ignored if not      ***
  ***          needed.  Generally this type of data is indented     ***
  ***          by one space.                                        ***
  ***                                                               ***
  *******************************************************************
  *
  *
  *******************************************************************
  ***                                                               ***
  ***   OTHER STUFF:  Additional information is needed in the       ***
  ***     SATLIT to create the grid input files for the grid        ***
  ***     generation package.  For each type of plane in both       ***
  ***     the X & Y directions the user must specify what region    ***
  ***     the 'circle' starts on.  For instance in the              ***
  ***     X-direction for the Type 1 it is the sixth region,        ***
  ***     therefore it is passed into SATLIT in the 17 slot         ***
  ***     (ie IG(117)) of the last cell number.  It is assumed      ***
  ***     that the first X-Coordinate is 0.0.  This is the case     ***
  ***     in all planes except the chimney.  In this instance the   ***
  ***     first X-distance is passed to SATLIT through the RG       ***
  ***     array element that is 10 above the logical unit used      ***
  ***     to write out the grid data file.  For this case it is     ***
  ***     the 9th plane (LU=69) and RG(79) is set to 63.0 inches    ***
  ***                                                               ***
  *******************************************************************
  *
  *
  *XXXXXXXXXXXXXXXXXXXX   DECLARE X   XXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
INTEGER(NRXA,NRXB,NRXBB,NRXC,NRXD)
INTEGER(NX01,NX02,NX03,NX04,NX05,NX06,NX07,NX08,NX09,NX10)
INTEGER(NX11,NX12,NX13,NX14)
INTEGER(NXAD,NXBD)
INTEGER(IXAF01,IXAF02,IXAF03,IXAF04,IXAF05)
INTEGER(IXAF06,IXAF07,IXAF08,IXAF09,IXAF10)
INTEGER(IXAF11,IXAF12,IXAF13,IXAF14,IXAF15)
INTEGER(IXAL01,IXAL02,IXAL03,IXAL04,IXAL05)
INTEGER(IXAL06,IXAL07,IXAL08,IXAL09,IXAL10)
INTEGER(IXAL11,IXAL12,IXAL13,IXAL14,IXAL15)
INTEGER(IXBF01,IXBF02,IXBF03,IXBF04,IXBF05)
INTEGER(IXBF06,IXBF07,IXBF08,IXBF09,IXBF10)
INTEGER(IXBF11,IXBF12,IXBF13,IXBF14,IXBF15)
INTEGER(IXBL01,IXBL02,IXBL03,IXBL04,IXBL05)
INTEGER(IXBL06,IXBL07,IXBL08,IXBL09,IXBL10)
INTEGER(IXBL11,IXBL12,IXBL13,IXBL14,IXBL15)
INTEGER(IXXF01,IXXF02,IXXF03,IXXF04,IXXF05)
INTEGER(IXXF06,IXXF07,IXXF08,IXXF09,IXXF10)
INTEGER(IXXF11,IXXF12,IXXF13,IXXF14,IXXF15)
INTEGER(IXXL01,IXXL02,IXXL03,IXXL04,IXXL05)
INTEGER(IXXL06,IXXL07,IXXL08,IXXL09,IXXL10)
INTEGER(IXXL11,IXXL12,IXXL13,IXXL14,IXXL15)
INTEGER(IXCF01,IXCF02,IXCF03,IXCF04,IXCF05)
INTEGER(IXCF06,IXCF07,IXCF08,IXCF09,IXCF10)
INTEGER(IXCF11,IXCF12,IXCF13,IXCF14,IXCF15)
INTEGER(IXCL01,IXCL02,IXCL03,IXCL04,IXCL05)
INTEGER(IXCL06,IXCL07,IXCL08,IXCL09,IXCL10)
INTEGER(IXCL11,IXCL12,IXCL13,IXCL14,IXCL15)
INTEGER(IXDF01,IXDF02,IXDF03,IXDF04,IXDF05)
INTEGER(IXDF06,IXDF07,IXDF08,IXDF09,IXDF10)
INTEGER(IXDF11,IXDF12,IXDF13,IXDF14,IXDF15)
INTEGER(IXDL01,IXDL02,IXDL03,IXDL04,IXDL05)
INTEGER(IXDL06,IXDL07,IXDL08,IXDL09,IXDL10)
INTEGER(IXDL11,IXDL12,IXDL13,IXDL14,IXDL15)
INTEGER(IXMON1,IXMON2,IXMON3,IXMON4,IXMON5)
INTEGER(IXMON6,IXMON7,IXMON8,IXMON9,ITMP)
REAL(XLA01,XLA02,XLA03,XLA04,XLA05)
REAL(XLA06,XLA07,XLA08,XLA09,XLA10)
REAL(XLA11,XLA12,XLA13,XLA14,XLA15)
REAL(XLB01,XLB02,XLB03,XLB04,XLB05)
REAL(XLB06,XLB07,XLB08,XLB09,XLB10)
REAL(XLB11,XLB12,XLB13,XLB14,XLB15)
REAL(XLBB01,XLBB02,XLBB03,XLBB04,XLBB05)
REAL(XLBB06,XLBB07,XLBB08,XLBB09,XLBB10)
REAL(XLBB11,XLBB12,XLBB13,XLBB14,XLBB15)
REAL(XLC01,XLC02,XLC03,XLC04,XLC05)
REAL(XLC06,XLC07,XLC08,XLC09,XLC10)
REAL(XLC11,XLC12,XLC13,XLC14,XLC15)
REAL(XLD01,XLD02,XLD03,XLD04,XLD05)
REAL(XLD06,XLD07,XLD08,XLD09,XLD10)
REAL(XLD11,XLD12,XLD13,XLD14,XLD15)
REAL(PXA01,PXA02,PXA03,PXA04,PXA05)
REAL(PXA06,PXA07,PXA08,PXA09,PXA10)
REAL(PXA11,PXA12,PXA13,PXA14,PXA15)
REAL(PXB01,PXB02,PXB03,PXB04,PXB05)
REAL(PXB06,PXB07,PXB08,PXB09,PXB10)
REAL(PXB11,PXB12,PXB13,PXB14,PXB15)
REAL(PXBB01,PXBB02,PXBB03,PXBB04,PXBB05)
REAL(PXBB06,PXBB07,PXBB08,PXBB09,PXBB10)
REAL(PXBB11,PXBB12,PXBB13,PXBB14,PXBB15)
REAL(PXC01,PXC02,PXC03,PXC04,PXC05)
REAL(PXC06,PXC07,PXC08,PXC09,PXC10)
REAL(PXC11,PXC12,PXC13,PXC14,PXC15)
REAL(PXD01,PXD02,PXD03,PXD04,PXD05)
REAL(PXD06,PXD07,PXD08,PXD09,PXD10)
REAL(PXD11,PXD12,PXD13,PXD14,PXD15)
REAL(XCENA,YCENA,XCENB,YCENB,XCENC,YCENC,XCEND,YCEND)
REAL(DDYNA,DENGI,DENGO,DAUGL,DAUGS,DAUGT,DAUGC,XINL)
REAL(DI1,DI2,DI3,DO1,DO2,DO3)
REAL(PI,DYNAW)
  *
  *
  *XXXXXXXXXXXXXXXXXXXXX    LOGICALS    XXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
LG(1)=T
LG(2)=T
LG(3)=T
LG(4)=T
  *
  *
  *XXXXXXXXXXXXXXXXXXXXX    CIRCLE CENTERS & DIAMETERS   YXXXXXXXXXXX*
  *
  *
PI=3.141592654
XCENA=87.0;             RG(41)=XCENA
YCENA=50.0;             RG(42)=YCENA
```

```
XCENB=XCENA;            RG(43)=XCENB
YCENB=YCENA;            RG(44)=YCENB
XCENC=XCENA+0.0;        RG(45)=XCENC
YCENC=YCENA+0.0;        RG(46)=YCENC
XCEND=XCENA;            RG(47)=XCEND
YCEND=YCENA;            RG(48)=YCEND


DDYNA=10.0;             RG(50)=DDYNA
DENGI=14.0;             RG(51)=DENGI

   @@@@@@@  SPECIFY WHEN USING TYPE 3  @@@@@@@
 IG(60)=2
 DI1=17.0;               RG(54)=DI1
 DI2=17.0;               RG(55)=DI2
 DI3=16.0;               RG(56)=DI3
 DO1=28.0;               RG(57)=DO1
 DO2=23.0;               RG(58)=DO2
 DO3=22.0;               RG(59)=DO3
   @@@@@@@  SPECIFY WHEN NOT USING TYPE 3  @@@@@@@
 DENGO=17.0;             RG(52)=DENGO
 DAUGL=28.0;             RG(53)=DAUGL

DAUGS=23.0;             RG(60)=DAUGS
DAUGT=24.0;             RG(61)=DAUGT
DAUGC=25.5;             RG(62)=DAUGC

XINL=108.0;             RG(65)=XINL
  *
  *
  *XXXXXXXXXXXXXXXXXXXX    TYPE 1 DATA   XXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
NRXA=13;                IG(42)=NRXA
NX01=3
NX02=3
NX03=2
NX04=2
NX05=1
NX06=5
   #######  MUST BE EVEN FOR CELLS IN CIRCLE  #######
NX07=6
NX08=5
NX09=1
NX10=2
NX11=2
NX12=4
NX13=4

IXAF01=       1;        IXAL01=      NX01
IXAF02=IXAL01+1;        IXAL02=IXAL01+NX02
IXAF03=IXAL02+1;        IXAL03=IXAL02+NX03
IXAF04=IXAL03+1;        IXAL04=IXAL03+NX04
IXAF05=IXAL04+1;        IXAL05=IXAL04+NX05
IXAF06=IXAL05+1;        IXAL06=IXAL05+NX06
IXAF07=IXAL06+1;        IXAL07=IXAL06+NX07
IXAF08=IXAL07+1;        IXAL08=IXAL07+NX08
IXAF09=IXAL08+1;        IXAL09=IXAL08+NX09
IXAF10=IXAL09+1;        IXAL10=IXAL09+NX10
IXAF11=IXAL10+1;        IXAL11=IXAL10+NX11
```

```
IXAF12=IXAL11+1;        IXAL12=IXAL11+NX12
IXAF13=IXAL12+1;        IXAL13=IXAL12+NX13

XLA01= 31.500000;       PXA01= 1.5
XLA02= 63.000000;       PXA02=-1.5
XLA03= 67.500000;       PXA03= 1.0
XLA04= 69.500000;       PXA04= 1.0
XLA05= 71.500000;       PXA05= 1.0
XLA06=  0.000000;       PXA06= 1.0
XLA07=  0.000000;       PXA07= 1.0
XLA08=102.500000;       PXA08= 1.0
XLA09=104.500000;       PXA09= 1.0
XLA10=106.500000;       PXA10= 1.0
XLA11=111.000000;       PXA11= 1.0
XLA12=175.500000;       PXA12= 1.5
XLA13=240.000000;       PXA13=-1.5
DYNAW=XLA08-XLA05

IG(101)=IXAL01;RG(101)=XLA01;RG(121)=PXA01
IG(102)=IXAL02;RG(102)=XLA02;RG(122)=PXA02
IG(103)=IXAL03;RG(103)=XLA03;RG(123)=PXA03
IG(104)=IXAL04;RG(104)=XLA04;RG(124)=PXA04
IG(105)=IXAL05;RG(105)=XLA05;RG(125)=PXA05
IG(106)=IXAL06;RG(106)=XLA06;RG(126)=PXA06
IG(107)=IXAL07;RG(107)=XLA07;RG(127)=PXA07
IG(108)=IXAL08;RG(108)=XLA08;RG(128)=PXA08
IG(109)=IXAL09;RG(109)=XLA09;RG(129)=PXA09
IG(110)=IXAL10;RG(110)=XLA10;RG(130)=PXA10
IG(111)=IXAL11;RG(111)=XLA11;RG(131)=PXA11
IG(112)=IXAL12;RG(112)=XLA12;RG(132)=PXA12
IG(113)=IXAL13;RG(113)=XLA13;RG(133)=PXA13
IG(117)=7
  *
  *
  *XXXXXXXXXXXXXXXXXXXX    TYPE 2 DATA   XXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
NXAD=1
NRXB=8;                IG(44)=NRXB
IXBF01=IXAF01;         IXBL01=IXAL01
IXBF02=IXAF02;         IXBL02=IXAL02
IXBF03=IXAF03;         IXBL03=IXAL06-NXAD
IXBF04=IXAF07-NXAD;    IXBL04=IXAL07-NX07/2
IXBF05=IXAF08-NX07/2;  IXBL05=IXAL07+NXAD
IXBF06=IXAF08+NXAD;    IXBL06=IXAL11
IXBF07=IXAF12;         IXBL07=IXAL12
IXBF08=IXAF13;         IXBL08=IXAL13

XLB01= XLA01;          PXB01= PXA01
XLB02= XLA02;          PXB02= PXA02
XLB03=  0.000000;      PXB03=-1.4
XLB04= XCENB;          PXB04= 1.6
XLB05=  0.000000;      PXB05=-1.6
XLB06= XLA11;          PXB06= 1.4
XLB07= XLA12;          PXB07= PXA12
XLB08= XLA13;          PXB08= PXA13

IG(141)=IXBL01;RG(181)=XLB01;RG(201)=PXB01
IG(142)=IXBL02;RG(182)=XLB02;RG(202)=PXB02
IG(143)=IXBL03;RG(183)=XLB03;RG(203)=PXB03
IG(144)=IXBL04;RG(184)=XLB04;RG(204)=PXB04
IG(145)=IXBL05;RG(185)=XLB05;RG(205)=PXB05
IG(146)=IXBL06;RG(186)=XLB06;RG(206)=PXB06
IG(147)=IXBL07;RG(187)=XLB07;RG(207)=PXB07
IG(148)=IXBL08;RG(188)=XLB08;RG(208)=PXB08
IG(157)=4
  *
  *
  *XXXXXXXXXXXXXXXXXXXX    TYPE 3 DATA   XXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
NXBD=4

   @@@@@@@  SPECIFY WHEN USING TYPE 3  @@@@@@@
 NRXBB=10;               IG(46)=NRXBB
 IXXF01=IXBF01;          IXXL01=IXBL01
 IXXF02=IXBF02;          IXXL02=IXBL02
 IXXF03=IXBF03;          IXXL03=IXBL03-NXBD
 IXXF04=IXBF04-NXBD;     IXXL04=IXBL03
 IXXF05=IXBF04;          IXXL05=IXBL04
 IXXF06=IXBF05;          IXXL06=IXBL05
 IXXF07=IXBF06;          IXXL07=IXBL05+NXBD
 IXXF08=IXBF06+NXBD;     IXXL08=IXBL06
 IXXF09=IXBF07;          IXXL09=IXBL07
 IXXF10=IXBF08;          IXXL10=IXBL08

 XLBB01= XLA01;          PXBB01= PXA01
 XLBB02= XLA02;          PXBB02= PXA02
 XLBB03=  0.000000;      PXBB03= PXB03
 XLBB04=  0.000000;      PXBB04= 1.0
 XLBB05= XCENB;          PXBB05= PXB04
 XLBB06=  0.000000;      PXBB06= PXB05
 XLBB07=  0.000000;      PXBB07= 1.0
 XLBB08= XLA11;          PXBB08= PXB06
 XLBB09= XLA12;          PXBB09= PXA12
 XLBB10= XLA13;          PXBB10= PXA13

 IG(181)=IXXL01;RG(261)=XLBB01;RG(281)=PXBB01
 IG(182)=IXXL02;RG(262)=XLBB02;RG(282)=PXBB02
 IG(183)=IXXL03;RG(263)=XLBB03;RG(283)=PXBB03
 IG(184)=IXXL04;RG(264)=XLBB04;RG(284)=PXBB04
 IG(185)=IXXL05;RG(265)=XLBB05;RG(285)=PXBB05
 IG(186)=IXXL06;RG(266)=XLBB06;RG(286)=PXBB06
 IG(187)=IXXL07;RG(267)=XLBB07;RG(287)=PXBB07
 IG(188)=IXXL08;RG(268)=XLBB08;RG(288)=PXBB08
 IG(189)=IXXL09;RG(269)=XLBB09;RG(289)=PXBB09
 IG(190)=IXXL10;RG(270)=XLBB10;RG(290)=PXBB10
 IG(197)=4
  *
  *
  *XXXXXXXXXXXXXXXXXXXX    TYPE 4 DATA   XXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
NRXC=8;                 IG(48)=NRXC
IXCF01=IXBF01;          IXCL01=IXBL01
IXCF02=IXBF02;          IXCL02=IXBL02
IXCF03=IXBF03;          IXCL03=IXBL03-NXBD
IXCF04=IXBF04-NXBD;     IXCL04=IXBL04
IXCF05=IXBF05;          IXCL05=IXBL05+NXBD
IXCF06=IXBF06+NXBD;     IXCL06=IXBL06
```

```
IXCF07=IXBF07;          IXCL07=IXBL07
IXCF08=IXBF08;          IXCL08=IXBL08

XLC01= XLA01;           PXC01= PXA01
XLC02= XLA02;           PXC02= PXA02
XLC03=  0.000000;       PXC03= PXB03
XLC04= XCENC;           PXC04= PXB04
XLC05=  0.000000;       PXC05= PXB05
XLC06= XLA11;           PXC06= PXB06
XLC07= XLA12;           PXC07= PXA12
XLC08= XLA13;           PXC08= PXA13

IG(221)=IXCL01;RG(341)=XLC01;RG(361)=PXC01
IG(222)=IXCL02;RG(342)=XLC02;RG(362)=PXC02
IG(223)=IXCL03;RG(343)=XLC03;RG(363)=PXC03
IG(224)=IXCL04;RG(344)=XLC04;RG(364)=PXC04
IG(225)=IXCL05;RG(345)=XLC05;RG(365)=PXC05
IG(226)=IXCL06;RG(346)=XLC06;RG(366)=PXC06
IG(227)=IXCL07;RG(347)=XLC07;RG(367)=PXC07
IG(228)=IXCL08;RG(348)=XLC08;RG(368)=PXC08
IG(237)=4
  *
  *
  *XXXXXXXXXXXXXXXXXXXXX    TYPE 5 DATA   XXXXXXXXXXXXXXXXXXXXXXXXXXX*
  *
  *
NRXD=4;                 IG(50)=NRXD
IXDF01=IXCF01;          IXDL01=IXCL03
IXDF02=IXCF04;          IXDL02=IXCL04
IXDF03=IXCF05;          IXDL03=IXCL05
IXDF04=IXCF06;          IXDL04=IXCL08

ITMP=77+IG(60)
RG(ITMP)=63.0
XLD01=  0.000000;       PXD01=-1.2
XLD02=  XCEND;          PXD02= PXB04
XLD03=  0.000000;       PXD03= PXB05
XLD04=111.000000;       PXD04= 1.2

IG(261)=IXDL01;RG(421)=XLD01;RG(441)=PXD01
IG(262)=IXDL02;RG(422)=XLD02;RG(442)=PXD02
IG(263)=IXDL03;RG(423)=XLD03;RG(443)=PXD03
IG(264)=IXDL04;RG(424)=XLD04;RG(444)=PXD04
IG(277)=2
  *
  ********************************************************************
  *********               Y-DIRECTION GRIDING                *********
  ********************************************************************
  ***                                                              ***
  ***   NRYA    --  Number of Y regions for Type 1 plane           ***
  ***   NRYB    --  Number of Y regions for Type 2 plane           ***
  ***   NRYBB   --  Number of Y regions for Type 3 plane           ***
  ***   NRYC    --  Number of Y regions for Type 4 plane           ***
  ***   NRYD    --  Number of Y regions for Type 5 plane           ***
  ***                                                              ***
  ***   NOTE:  The number of grid cells is define for the Type 1   ***
  ***          plane and then redistributed for the other types.   ***
  ***          There are fourteen available regions, some may      ***
  ***          not be used.                                        ***
  ***                                                              ***
***   NY01     --   Number of cells in 1st region -> Floor to       ***
***                 bottom of cart                                  ***
***   NY02     --   Number of cells in 2nd region -> Bottom of      ***
***                 cart to top of cart                             ***
***   NY03     --   Number of cells in 3rd region -> Top of cart    ***
***                 to bottom of dynamometer opening                ***
***   NY04     --   Number of cells in 4th region -> Bottom of      ***
***                 dynamometer opening to top dyna opening         ***
***   NY05     --   Number of cells in 5th region -> Top of         ***
***                 dynamometer opening to bottom dyna skirt        ***
***   NY06     --   Number of cells in 6th region -> Bottom of      ***
***                 dynamometer skirt to top of dynamometer         ***
***   NY07     --   Number of cells in 7th region -> Top of         ***
***                 dynamometer to bottom dynamometer exhaust       ***
***   NY08     --   Number of cells in 8th region -> Bottom of      ***
***                 dynamometer exhaust to top of dyna sleeve       ***
***   NY09     --   Number of cells in 9th region -> Top of         ***
***                 dynamometer sleeve to midpoint roof             ***
***   NY10     --   Number of cells in 10th region -> Midpoint      ***
***                 roof to roof                                    ***
***   NY11     --   Number of cells in 11th region -> Spare         ***
***   NY12     --   Number of cells in 12th region -> Spare         ***
***   NY13     --   Number of cells in 13th region -> Spare         ***
***   NY14     --   Number of cells in 14th region -> Spare         ***
***                                                                 ***
***   NOTE:  The regions for the other 5 Types will now also        ***
***          be defined.                                            ***
***   TYPE 2                                                        ***
***     Region 1  --  Floor to bottom of cart                       ***
***     Region 2  --  Bottom of cart to top of cart                 ***
***     Region 3  --  Top of cart to engine                         ***
***     Region 4  --  Engine to midpoint engine                     ***
***     Region 5  --  Midpoint engine to engine                     ***
***     Region 6  --  Engine to top of skirt                        ***
***     Region 7  --  Top of skirt to midpoint roof                 ***
***     Region 8  --  Midpoint roof to roof                         ***
***   TYPE 3                                                        ***
***     Region 1  --  Floor to bottom of cart                       ***
***     Region 2  --  Bottom of cart to top of cart                 ***
***     Region 3  --  Top of cart to augmenter tube                 ***
***     Region 4  --  Augmenter tube to engine                      ***
***     Region 5  --  Engine to midpoint engine                     ***
***     Region 6  --  Midpoint engine to engine                     ***
***     Region 7  --  Engine to augmenter tube                      ***
***     Region 8  --  Augmenter tube to top of skirt                ***
***     Region 9  --  Top of skirt to midpoint roof                 ***
***     Region 10 --  Midpoint roof to roof                         ***
***   TYPE 4                                                        ***
***     Region 1  --  Floor to bottom of cart                       ***
***     Region 2  --  Bottom of cart to top of cart                 ***
***     Region 3  --  Top of cart to augmenter tube                 ***
***     Region 4  --  Augmenter tube to midpoint aug tube           ***
***     Region 5  --  Midpoint augmenter tube to aug tube           ***
***     Region 6  --  Augmenter tube to top of skirt                ***
***     Region 7  --  Top of skirt to midpoint roof                 ***
***     Region 8  --  Midpoint roof to roof                         ***
***   TYPE 5                                                        ***
***     Region 1  --  Floor to augmenter tube                       ***
***     Region 2  --  Augmenter tube to midpoint aug tube           ***
***     Region 3  --  Midpoint augmenter tube to aug tube           ***
```

```
  ***     Region 4 --   Augmenter tube to center of curvature      ***
  ***   TYPE 6                                                     ***
  ***     Region 1 --   Wall to wall                               ***
  ***                                                              ***
  ***   NYAD    --  Number of cells in Y-direction picked up by    ***
  ***               the engine                                     ***
  ***   NYBD    --  Number of cells in Y-directions picked up by   ***
  ***               the augmenter tube                             ***
  ***   NOTE:  This last two items have corresponding parameters   ***
  ***          for the X-direction.  Generally they will be the    ***
  ***          the same.                                           ***
  ***                                                              ***
  ***   IYAF**  --  First cell number of ** region Type 1          ***
  ***   IYAL**  --  Last cell number of ** region Type 1           ***
  ***   IYBF**  --  First cell number of ** region Type 2          ***
  ***   IYBL**  --  Last cell number of ** region Type 2           ***
  ***   IYYF**  --  First cell number of ** region Type 3          ***
  ***   IYYL**  --  Last cell number of ** region Type 3           ***
  ***   IYCF**  --  First cell number of ** region Type 4          ***
  ***   IYCL**  --  Last cell number of ** region Type 4           ***
  ***   IYDF**  --  First cell number of ** region Type 5          ***
  ***   IYDL**  --  Last cell number of ** region Type 5           ***
  ***                                                              ***
  ***   IYMON*  --  Location of * monitoring point (9 extra)       ***
  ***                                                              ***
  ***   YLA**   --  Length to end of ** region Type 1 (in)         ***
  ***   YLB**   --  Length to end of ** region Type 2 (in)         ***
  ***   YLBB**  --  Length to end of ** region Type 3 (in)         ***
  ***   YLC**   --  Length to end of ** region Type 4 (in)         ***
  ***   YLD**   --  Length to end of ** region Type 5 (in)         ***
  ***                                                              ***
  ***   PYA**   --  Clustering factor of ** region Type 1          ***
  ***   PYB**   --  Clustering factor of ** region Type 2          ***
  ***   PYBB**  --  Clustering factor of ** region Type 3          ***
  ***   PYC**   --  Clustering factor of ** region Type 4          ***
  ***   PYD**   --  Clustering factor of ** region Type 5          ***
  ***                                                              ***
  ********************************************************************
  *
  *
  *YYYYYYYYYYYYYYYYYYYYY   DECLARE Y   YYYYYYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
INTEGER(NRYA,NRYB,NRYBB,NRYC,NRYD)
INTEGER(NYAD,NYBD)
INTEGER(NY01,NY02,NY03,NY04,NY05,NY06,NY07,NY08,NY09,NY10)
INTEGER(NY11,NY12,NY13,NY14)
INTEGER(IYAF01,IYAF02,IYAF03,IYAF04,IYAF05)
INTEGER(IYAF06,IYAF07,IYAF08,IYAF09,IYAF10)
INTEGER(IYAF11,IYAF12,IYAF13,IYAF14,IYAF15)
INTEGER(IYAL01,IYAL02,IYAL03,IYAL04,IYAL05)
INTEGER(IYAL06,IYAL07,IYAL08,IYAL09,IYAL10)
INTEGER(IYAL11,IYAL12,IYAL13,IYAL14,IYAL15)
INTEGER(IYBF01,IYBF02,IYBF03,IYBF04,IYBF05)
INTEGER(IYBF06,IYBF07,IYBF08,IYBF09,IYBF10)
INTEGER(IYBF11,IYBF12,IYBF13,IYBF14,IYBF15)
INTEGER(IYBL01,IYBL02,IYBL03,IYBL04,IYBL05)
INTEGER(IYBL06,IYBL07,IYBL08,IYBL09,IYBL10)
INTEGER(IYBL11,IYBL12,IYBL13,IYBL14,IYBL15)
INTEGER(IYYF01,IYYF02,IYYF03,IYYF04,IYYF05)
INTEGER(IYYF06,IYYF07,IYYF08,IYYF09,IYYF10)
INTEGER(IYYF11,IYYF12,IYYF13,IYYF14,IYYF15)
INTEGER(IYYL01,IYYL02,IYYL03,IYYL04,IYYL05)
INTEGER(IYYL06,IYYL07,IYYL08,IYYL09,IYYL10)
INTEGER(IYYL11,IYYL12,IYYL13,IYYL14,IYYL15)
INTEGER(IYCF01,IYCF02,IYCF03,IYCF04,IYCF05)
INTEGER(IYCF06,IYCF07,IYCF08,IYCF09,IYCF10)
INTEGER(IYCF11,IYCF12,IYCF13,IYCF14,IYCF15)
INTEGER(IYCL01,IYCL02,IYCL03,IYCL04,IYCL05)
INTEGER(IYCL06,IYCL07,IYCL08,IYCL09,IYCL10)
INTEGER(IYCL11,IYCL12,IYCL13,IYCL14,IYCL15)
INTEGER(IYDF01,IYDF02,IYDF03,IYDF04,IYDF05)
INTEGER(IYDF06,IYDF07,IYDF08,IYDF09,IYDF10)
INTEGER(IYDF11,IYDF12,IYDF13,IYDF14,IYDF15)
INTEGER(IYDL01,IYDL02,IYDL03,IYDL04,IYDL05)
INTEGER(IYDL06,IYDL07,IYDL08,IYDL09,IYDL10)
INTEGER(IYDL11,IYDL12,IYDL13,IYDL14,IYDL15)
INTEGER(IYMON1,IYMON2,IYMON3,IYMON4,IYMON5)
INTEGER(IYMON6,IYMON7,IYMON8,IYMON9)
REAL(YLA01,YLA02,YLA03,YLA04,YLA05)
REAL(YLA06,YLA07,YLA08,YLA09,YLA10)
REAL(YLA11,YLA12,YLA13,YLA14,YLA15)
REAL(YLB01,YLB02,YLB03,YLB04,YLB05)
REAL(YLB06,YLB07,YLB08,YLB09,YLB10)
REAL(YLB11,YLB12,YLB13,YLB14,YLB15)
REAL(YLBB01,YLBB02,YLBB03,YLBB04,YLBB05)
REAL(YLBB06,YLBB07,YLBB08,YLBB09,YLBB10)
REAL(YLBB11,YLBB12,YLBB13,YLBB14,YLBB15)
REAL(YLC01,YLC02,YLC03,YLC04,YLC05)
REAL(YLC06,YLC07,YLC08,YLC09,YLC10)
REAL(YLC11,YLC12,YLC13,YLC14,YLC15)
REAL(YLD01,YLD02,YLD03,YLD04,YLD05)
REAL(YLD06,YLD07,YLD08,YLD09,YLD10)
REAL(YLD11,YLD12,YLD13,YLD14,YLD15)
REAL(PYA01,PYA02,PYA03,PYA04,PYA05)
REAL(PYA06,PYA07,PYA08,PYA09,PYA10)
REAL(PYA11,PYA12,PYA13,PYA14,PYA15)
REAL(PYB01,PYB02,PYB03,PYB04,PYB05)
REAL(PYB06,PYB07,PYB08,PYB09,PYB10)
REAL(PYB11,PYB12,PYB13,PYB14,PYB15)
REAL(PYBB01,PYBB02,PYBB03,PYBB04,PYBB05)
REAL(PYBB06,PYBB07,PYBB08,PYBB09,PYBB10)
REAL(PYBB11,PYBB12,PYBB13,PYBB14,PYBB15)
REAL(PYC01,PYC02,PYC03,PYC04,PYC05)
REAL(PYC06,PYC07,PYC08,PYC09,PYC10)
REAL(PYC11,PYC12,PYC13,PYC14,PYC15)
REAL(PYD01,PYD02,PYD03,PYD04,PYD05)
REAL(PYD06,PYD07,PYD08,PYD09,PYD10)
REAL(PYD11,PYD12,PYD13,PYD14,PYD15)
  *
  *
  *YYYYYYYYYYYYYYYYYYYY    TYPE 1 DATA   YYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
NRYA=10;               IG(43)=NRYA
NY01=4
NY02=1
NY03=8
   #######  MUST BE EVEN FOR CELLS IN CIRCLE  #######
NY04=6
```

```
NY05=4
NY06=2
NY07=2
NY08=2
NY09=3
NY10=3

IYAF01=       1;        IYAL01=       NY01
IYAF02=IYAL01+1;        IYAL02=IYAL01+NY02
IYAF03=IYAL02+1;        IYAL03=IYAL02+NY03
IYAF04=IYAL03+1;        IYAL04=IYAL03+NY04
IYAF05=IYAL04+1;        IYAL05=IYAL04+NY05
IYAF06=IYAL05+1;        IYAL06=IYAL05+NY06
IYAF07=IYAL06+1;        IYAL07=IYAL06+NY07
IYAF08=IYAL07+1;        IYAL08=IYAL07+NY08
IYAF09=IYAL08+1;        IYAL09=IYAL08+NY09
IYAF10=IYAL09+1;        IYAL10=IYAL09+NY10

YLA01= 19.000000;       PYA01= 1.0
YLA02= 25.000000;       PYA02= 1.0
YLA03=  0.000000;       PYA03= 1.0
YLA04=  0.000000;       PYA04= 1.0
YLA05= 64.000000;       PYA05= 1.0
YLA06= 66.750000;       PYA06= 1.0
YLA07= 68.000000;       PYA07= 1.0
YLA08= 72.000000;       PYA08= 1.0
YLA09=102.000000;       PYA09= 1.5
YLA10=132.000000;       PYA10=-1.5

IG(121)=IYAL01;RG(141)=YLA01;RG(161)=PYA01
IG(122)=IYAL02;RG(142)=YLA02;RG(162)=PYA02
IG(123)=IYAL03;RG(143)=YLA03;RG(163)=PYA03
IG(124)=IYAL04;RG(144)=YLA04;RG(164)=PYA04
IG(125)=IYAL05;RG(145)=YLA05;RG(165)=PYA05
IG(126)=IYAL06;RG(146)=YLA06;RG(166)=PYA06
IG(127)=IYAL07;RG(147)=YLA07;RG(167)=PYA07
IG(128)=IYAL08;RG(148)=YLA08;RG(168)=PYA08
IG(129)=IYAL09;RG(149)=YLA09;RG(169)=PYA09
IG(130)=IYAL10;RG(150)=YLA10;RG(170)=PYA10
IG(137)=4
  *
  *
  *YYYYYYYYYYYYYYYYYYYYY    TYPE 2 DATA   YYYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
NYAD=1
NRYB=8;                 IG(45)=NRYB
IYBF01=IYAF01;          IYBL01=IYAL01
IYBF02=IYAF02;          IYBL02=IYAL02
IYBF03=IYAF03;          IYBL03=IYAL03-NYAD
IYBF04=IYAF04-NYAD;     IYBL04=IYAL04-NY04/2
IYBF05=IYAF05-NY04/2;   IYBL05=IYAL04+NYAD
IYBF06=IYAF05+NYAD;     IYBL06=IYAL08
IYBF07=IYAF09;          IYBL07=IYAL09
IYBF08=IYAF10;          IYBL08=IYAL10

YLB01= YLA01;           PYB01= PYA01
YLB02= YLA02;           PYB02= PYA02
YLB03=  0.000000;       PYB03=-1.4
YLB04=  YCENB;          PYB04= 1.6
```

```
YLB05=  0.000000;         PYB05=-1.6
YLB06= YLA08;             PYB06= 1.4
YLB07= YLA09;             PYB07= PYA09
YLB08= YLA10;             PYB08= PYA10

IG(161)=IYBL01;RG(221)=YLB01;RG(241)=PYB01
IG(162)=IYBL02;RG(222)=YLB02;RG(242)=PYB02
IG(163)=IYBL03;RG(223)=YLB03;RG(243)=PYB03
IG(164)=IYBL04;RG(224)=YLB04;RG(244)=PYB04
IG(165)=IYBL05;RG(225)=YLB05;RG(245)=PYB05
IG(166)=IYBL06;RG(226)=YLB06;RG(246)=PYB06
IG(167)=IYBL07;RG(227)=YLB07;RG(247)=PYB07
IG(168)=IYBL08;RG(228)=YLB08;RG(248)=PYB08
IG(177)=4
  *
  *
  *YYYYYYYYYYYYYYYYYYYYY    TYPE 3 DATA   YYYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
NYBD=4
  @@@@@@@  SPECIFY WHEN USING TYPE 3  @@@@@@@
 NRYBB=10;                 IG(47)=NRYBB
 IYYF01=IYBF01;            IYYL01=IYBL01
 IYYF02=IYBF02;            IYYL02=IYBL02
 IYYF03=IYBF03;            IYYL03=IYBL03-NYBD
 IYYF04=IYBF04-NYBD;       IYYL04=IYBL03
 IYYF05=IYBF04;            IYYL05=IYBL04
 IYYF06=IYBF05;            IYYL06=IYBL05
 IYYF07=IYBF06;            IYYL07=IYBL05+NYBD
 IYYF08=IYBF06+NYBD;       IYYL08=IYBL06
 IYYF09=IYBF07;            IYYL09=IYBL07
 IYYF10=IYBF08;            IYYL10=IYBL08

 YLBB01= YLA01;            PYBB01= PYA01
 YLBB02= YLA02;            PYBB02= PYA02
 YLBB03=  0.000000;        PYBB03= PYB03
 YLBB04=  0.000000;        PYBB04= 1.0
 YLBB05=  YCENB;           PYBB05= PYB04
 YLBB06=  0.000000;        PYBB06= PYB05
 YLBB07=  0.000000;        PYBB07= 1.0
 YLBB08= YLA08;            PYBB08= PYB06
 YLBB09= YLA09;            PYBB09= PYA09
 YLBB10= YLA10;            PYBB10= PYA10

 IG(201)=IYYL01;RG(301)=YLBB01;RG(321)=PYBB01
 IG(202)=IYYL02;RG(302)=YLBB02;RG(322)=PYBB02
 IG(203)=IYYL03;RG(303)=YLBB03;RG(323)=PYBB03
 IG(204)=IYYL04;RG(304)=YLBB04;RG(324)=PYBB04
 IG(205)=IYYL05;RG(305)=YLBB05;RG(325)=PYBB05
 IG(206)=IYYL06;RG(306)=YLBB06;RG(326)=PYBB06
 IG(207)=IYYL07;RG(307)=YLBB07;RG(327)=PYBB07
 IG(208)=IYYL08;RG(308)=YLBB08;RG(328)=PYBB08
 IG(209)=IYYL09;RG(309)=YLBB09;RG(329)=PYBB09
 IG(210)=IYYL10;RG(310)=YLBB10;RG(330)=PYBB10
 IG(217)=4
  *
  *
  *YYYYYYYYYYYYYYYYYYYYY    TYPE 4 DATA   YYYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
```

```
NRYC=8;                  IG(49)=NRYC
IYCF01=IYBF01;           IYCL01=IYBL01
IYCF02=IYBF02;           IYCL02=IYBL02
IYCF03=IYBF03;           IYCL03=IYBL03-NYBD
IYCF04=IYBF04-NYBD;      IYCL04=IYBL04
IYCF05=IYBF05;           IYCL05=IYBL05+NYBD
IYCF06=IYBF06+NYBD;      IYCL06=IYBL06
IYCF07=IYBF07;           IYCL07=IYBL07
IYCF08=IYBF08;           IYCL08=IYBL08

YLC01= YLA01;            PYC01= PYA01
YLC02= YLA02;            PYC02= PYA02
YLC03=  0.000000;        PYC03= PYB03
YLC04=  YCENC;           PYC04= PYB04
YLC05=  0.000000;        PYC05= PYB05
YLC06= YLA08;            PYC06= PYB06
YLC07= YLA09;            PYC07= PYA09
YLC08= YLA10;            PYC08= PYA10

IG(241)=IYCL01;RG(381)=YLC01;RG(401)=PYC01
IG(242)=IYCL02;RG(382)=YLC02;RG(402)=PYC02
IG(243)=IYCL03;RG(383)=YLC03;RG(403)=PYC03
IG(244)=IYCL04;RG(384)=YLC04;RG(404)=PYC04
IG(245)=IYCL05;RG(385)=YLC05;RG(405)=PYC05
IG(246)=IYCL06;RG(386)=YLC06;RG(406)=PYC06
IG(247)=IYCL07;RG(387)=YLC07;RG(407)=PYC07
IG(248)=IYCL08;RG(388)=YLC08;RG(408)=PYC08
IG(257)=4
  *
  *
  *YYYYYYYYYYYYYYYYYYYYY    TYPE 5 DATA   YYYYYYYYYYYYYYYYYYYYYYYYYYYY*
  *
  *
NRYD=4;                  IG(51)=NRYD
IYDF01=IYCF01;           IYDL01=IYCL03
IYDF02=IYCF04;           IYDL02=IYCL04
IYDF03=IYCF05;           IYDL03=IYCL05
IYDF04=IYCF06;           IYDL04=IYCL08

YLD01=  0.000000;        PYD01=-1.4
YLD02=  YCEND;           PYD02= PYB04
YLD03=  0.000000;        PYD03= PYB05
YLD04= 85.000000;        PYD04= 1.4

IG(281)=IYDL01;RG(461)=YLD01;RG(481)=PYD01
IG(282)=IYDL02;RG(462)=YLD02;RG(482)=PYD02
IG(283)=IYDL03;RG(463)=YLD03;RG(483)=PYD03
IG(284)=IYDL04;RG(464)=YLD04;RG(484)=PYD04
IG(297)=2
  *
  ***********************************************************************
  *********                Z-DIRECTION GRIDING                  *********
  ***********************************************************************
  ***                                                                 ***
  ***   NOTE:  With the X-Y gird information, several planes of       ***
  ***          grid points will be produced in the SATLIT.  In        ***
  ***          this section the user must specify how these           ***
  ***          planes are then stacked, blended, or rotated.          ***
  ***          There will be a plane of data for the front face       ***
  ***          of each of the following regions.                      ***
***                                                              ***
***   NCS     --  Number of regions in Z-direction               ***
***                                                              ***
***                                                              ***
***   NZ01    --  Number of cells in 1st region -> Front wall    ***
***               to end of wall extension (or midpoint to cart) ***
***   NZ02    --  Number of cells in 2nd region -> End of wall   ***
***               extension to front of cart                     ***
***   NZ03    --  Number of cells in 3rd region -> Front of      ***
***               cart to front of dynamometer skirt             ***
***   NZ04    --  Number of cells in 4th region -> Front of      ***
***               dynamometer skirt to outside front of dyna     ***
***   NZ05    --  Number of cells in 5th region -> Outside       ***
***               front of dynamometer to front of dyna exhaust  ***
***   NZ06    --  Number of cells in 6th region -> Front of      ***
***               dynamometer exhaust to inside front of dyna    ***
***   NZ07    --  Number of cells in 7th region -> Inside        ***
***               front of dynamometer to back of dyna exhaust   ***
***   NZ08    --  Number of cells in 8th region -> Back of       ***
***               dynamometer exhaust to inside back of dyna     ***
***   NZ09    --  Number of cells in 9th region -> Inside back   ***
***               of dynamometer to outside back of dyna         ***
***   NZ10    --  Number of cells in 10th region -> Outside      ***
***               back of dynamometer to back of dyna skirt      ***
***   NZ11    --  Number of cells in 11th region -> Back of      ***
***               dynamometer skirt to plate                     ***
***   NZ12    --  Number of cells in 12th region -> Plate to     ***
***               engine inlet                                   ***
***   NZ13    --  Number of cells in 13th region -> Engine       ***
***               inlet to end of cart                           ***
***   NZ14    --  Number of cells in 14th region -> End of       ***
***               cart to start of nozzle                        ***
***   NZ15    --  Number of cells in 15th region -> Start of     ***
***               nozzle to end of nozzle                        ***
***   NZ16    --  Number of cells in 16th region -> End of       ***
***               nozzle to augmenter lip                        ***
***   NZ17    --  Number of cells in 17th region -> Augmenter    ***
***               lip to start of augmenter sleeve               ***
***   NZ18    --  Number of cells in 18th region -> Start of     ***
***               augmenter sleeve to end augmenter sleeve       ***
***   NZ19    --  Number of cells in 19th region -> End of       ***
***               augmenter sleeve to augmenter tube             ***
***               ASSUMPTION:  This is an arbitrary region to    ***
***               make up for the difference in diameter.        ***
***   NZ20    --  Number of cells in 20th region -> Augmenter    ***
***               tube to midpoint of wall                       ***
***   NZ21    --  Number of cells in 21th region -> Midpoint     ***
***               of wall to front of wall                       ***
***   NZ22    --  Number of cells in 22th region -> Front of     ***
***               wall to back of wall                           ***
***   NZ23    --  Number of cells in 23th region -> Back of      ***
***               wall to end of augmenter tube                  ***
***   NZ24    --  Number of cells in 24th region -> End of       ***
***               augmenter tube to end of domain                ***
***   NZ25    --  Number of cells in 25th region -> Spare        ***
***                                                              ***
***   IZF**   --  First cell number of ** region                 ***
***   IZL**   --  Last cell number of ** region                  ***
***                                                              ***
***   IZMON*  --  Location of * monitoring point (9 extra)       ***
```

```
  ***                                                              ***
  ***   ZL**    --  Length to end of ** region (in)                ***
  ***                                                              ***
  ***   PZ**    --  Clustering factor of ** region                 ***
  ***                                                              ***
  ***   DYNAL   --. Z-direction width of dynamometer               ***
  ***                                                              ***
  ********************************************************************
  *
  *
  *ZZZZZZZZZZZZZZZZZZZZZ   DECLARE Z   ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ*
  *
  *
INTEGER(NCS)
INTEGER(NZ01,NZ02,NZ03,NZ04,NZ05,NZ06,NZ07,NZ08,NZ09,NZ10)
INTEGER(NZ11,NZ12,NZ13,NZ14,NZ15,NZ16,NZ17,NZ18,NZ19,NZ20)
INTEGER(NZ21,NZ22,NZ23,NZ24,NZ25)
INTEGER(IZF01,IZF02,IZF03,IZF04,IZF05)
INTEGER(IZF06,IZF07,IZF08,IZF09,IZF10)
INTEGER(IZF11,IZF12,IZF13,IZF14,IZF15)
INTEGER(IZF16,IZF17,IZF18,IZF19,IZF20)
INTEGER(IZF21,IZF22,IZF23,IZF24,IZF25)
INTEGER(IZL01,IZL02,IZL03,IZL04,IZL05)
INTEGER(IZL06,IZL07,IZL08,IZL09,IZL10)
INTEGER(IZL11,IZL12,IZL13,IZL14,IZL15)
INTEGER(IZL16,IZL17,IZL18,IZL19,IZL20)
INTEGER(IZL21,IZL22,IZL23,IZL24,IZL25)
INTEGER(IZMON1,IZMON2,IZMON3,IZMON4,IZMON5)
INTEGER(IZMON6,IZMON7,IZMON8,IZMON9)
REAL(ZL01,ZL02,ZL03,ZL04,ZL05)
REAL(ZL06,ZL07,ZL08,ZL09,ZL10)
REAL(ZL11,ZL12,ZL13,ZL14,ZL15)
REAL(ZL16,ZL17,ZL18,ZL19,ZL20)
REAL(ZL21,ZL22,ZL23,ZL24,ZL25)
REAL(PZ01,PZ02,PZ03,PZ04,PZ05)
REAL(PZ06,PZ07,PZ08,PZ09,PZ10)
REAL(PZ11,PZ12,PZ13,PZ14,PZ15)
REAL(PZ16,PZ17,PZ18,PZ19,PZ20)
REAL(PZ21,PZ22,PZ23,PZ24,PZ25)
REAL(DYNAL)
  *
  *
  *ZZZZZZZZZZZZZZZZZZZZZ    GEOMETRY & STACKING INFO   ZZZZZZZZZZZZZZZ*
  *
  *
NCS=24;                 IG(501)=NCS
NZ01=3
NZ02=3
NZ03=4
NZ04=2
NZ05=1
NZ06=1
NZ07=4
NZ08=1
NZ09=1
NZ10=2
NZ11=2
NZ12=4
NZ13=3
NZ14=2
```

```
NZ15=4
NZ16=2
NZ17=2
NZ18=4
NZ19=2
NZ20=6
NZ21=6
NZ22=2
   #######  MUST BE EVEN FOR CELLS IN BEND #######
NZ23=10
NZ24=6


IZF01=      1;        IZL01=      NZ01
IZF02=IZL01+1;        IZL02=IZL01+NZ02
IZF03=IZL02+1;        IZL03=IZL02+NZ03
IZF04=IZL03+1;        IZL04=IZL03+NZ04
IZF05=IZL04+1;        IZL05=IZL04+NZ05
IZF06=IZL05+1;        IZL06=IZL05+NZ06
IZF07=IZL06+1;        IZL07=IZL06+NZ07
IZF08=IZL07+1;        IZL08=IZL07+NZ08
IZF09=IZL08+1;        IZL09=IZL08+NZ09
IZF10=IZL09+1;        IZL10=IZL09+NZ10
IZF11=IZL10+1;        IZL11=IZL10+NZ11
IZF12=IZL11+1;        IZL12=IZL11+NZ12
IZF13=IZL12+1;        IZL13=IZL12+NZ13
IZF14=IZL13+1;        IZL14=IZL13+NZ14
IZF15=IZL14+1;        IZL15=IZL14+NZ15
IZF16=IZL15+1;        IZL16=IZL15+NZ16
IZF17=IZL16+1;        IZL17=IZL16+NZ17
IZF18=IZL17+1;        IZL18=IZL17+NZ18
IZF19=IZL18+1;        IZL19=IZL18+NZ19
IZF20=IZL19+1;        IZL20=IZL19+NZ20
IZF21=IZL20+1;        IZL21=IZL20+NZ21
IZF22=IZL21+1;        IZL22=IZL21+NZ22
IZF23=IZL22+1;        IZL23=IZL22+NZ23
IZF24=IZL23+1;        IZL24=IZL23+NZ24

ZL01= 48.0;           PZ01= 1.0
ZL02=107.0;           PZ02= 1.3
ZL03=181.25;          PZ03=-1.6
ZL04=184.5;           PZ04= 1.0
ZL05=185.5;           PZ05= 1.0
ZL06=186.5;           PZ06= 1.0
ZL07=202.5;           PZ07= 1.0
ZL08=203.5;           PZ08= 1.0
ZL09=205.5;           PZ09= 1.0
ZL10=206.75;          PZ10= 1.0
ZL11=211.5;           PZ11= 1.0
ZL12=222.0;           PZ12= 1.0
ZL13=255.0;           PZ13= 1.5
ZL14=267.0;           PZ14= 1.0
ZL15=283.0;           PZ15=-1.4
ZL16=285.5;           PZ16= 1.0
ZL17=288.0;           PZ17= 1.0
ZL18=323.0;           PZ18= 1.4
ZL19=332.0;           PZ19= 1.0
ZL20=414.0;           PZ20= 1.6
ZL21=496.0;           PZ21=-1.4
ZL22=508.0;           PZ22= 1.0
```

```
ZL23=568.0;              PZ23= 1.0
ZL24=568.0;              PZ24= 1.2
DYNAL=ZL08-ZL06

IG(511)=NZ01;RG(511)=ZL01;RG(541)=PZ01
IG(512)=NZ02;RG(512)=ZL02;RG(542)=PZ02
IG(513)=NZ03;RG(513)=ZL03;RG(543)=PZ03
IG(514)=NZ04;RG(514)=ZL04;RG(544)=PZ04
IG(515)=NZ05;RG(515)=ZL05;RG(545)=PZ05
IG(516)=NZ06;RG(516)=ZL06;RG(546)=PZ06
IG(517)=NZ07;RG(517)=ZL07;RG(547)=PZ07
IG(518)=NZ08;RG(518)=ZL08;RG(548)=PZ08
IG(519)=NZ09;RG(519)=ZL09;RG(549)=PZ09
IG(520)=NZ10;RG(520)=ZL10;RG(550)=PZ10
IG(521)=NZ11;RG(521)=ZL11;RG(551)=PZ11
IG(522)=NZ12;RG(522)=ZL12;RG(552)=PZ12
IG(523)=NZ13;RG(523)=ZL13;RG(553)=PZ13
IG(524)=NZ14;RG(524)=ZL14;RG(554)=PZ14
IG(525)=NZ15;RG(525)=ZL15;RG(555)=PZ15
IG(526)=NZ16;RG(526)=ZL16;RG(556)=PZ16
IG(527)=NZ17;RG(527)=ZL17;RG(557)=PZ17
IG(528)=NZ18;RG(528)=ZL18;RG(558)=PZ18
IG(529)=NZ19;RG(529)=ZL19;RG(559)=PZ19
IG(530)=NZ20;RG(530)=ZL20;RG(560)=PZ20
IG(531)=NZ21;RG(531)=ZL21;RG(561)=PZ21
IG(532)=NZ22;RG(532)=ZL22;RG(562)=PZ22
IG(533)=NZ23;RG(533)=ZL23;RG(563)=PZ23
IG(534)=NZ24;RG(534)=ZL24;RG(564)=PZ24
   #######  IG WHERE CHIMNEY STARTS --  RG HEIGHT TO BAFFLES   #######
IG(537)=23;RG(537)=YLA10

IG(541)=1;IG(571)=61;IG(601)=61
IG(542)=2;IG(572)=61;IG(602)=62
IG(543)=1;IG(573)=62;IG(603)=62
IG(544)=2;IG(574)=62;IG(604)=63
IG(545)=1;IG(575)=63;IG(605)=63
IG(546)=1;IG(576)=63;IG(606)=63
IG(547)=1;IG(577)=63;IG(607)=63
IG(548)=1;IG(578)=63;IG(608)=63
JG(549)=1;IG(579)=63;IG(609)=63
IG(550)=1;IG(580)=63;IG(610)=63
IG(551)=1;IG(581)=63;IG(611)=63
IG(552)=2;IG(582)=63;IG(612)=64
IG(553)=1;IG(583)=64;IG(613)=64
IG(554)=1;IG(584)=64;IG(614)=64
IG(555)=2;IG(585)=64;IG(615)=65
IG(556)=1;IG(586)=65;IG(616)=65
IG(557)=2;IG(587)=65;IG(617)=66
IG(558)=2;IG(588)=66;IG(618)=67
IG(559)=2;IG(589)=67;IG(619)=68
IG(560)=1;IG(590)=68;IG(620)=68
IG(561)=1;IG(591)=68;IG(621)=68
IG(562)=2;IG(592)=68;IG(622)=69
IG(563)=3;IG(593)=69;IG(623)=69
IG(564)=4;IG(594)=69;IG(624)=70
    GROUP 2. Transience; time-step specification
    GROUP 3. X-direction grid specification
NX=NX01+NX02+NX03+NX04+NX05+NX06+NX07+NX08+NX09
NX=NX+NX10+NX11+NX12+NX13+NX14
    GROUP 4. Y-direction grid specification
```

```
NY=NY01+NY02+NY03+NY04+NY05+NY06+NY07+NY08+NY09
NY=NY+NY10+NY11+NY12+NY13+NY14
    GROUP 5. Z-direction grid specification
NZ=NZ01+NZ02+NZ03+NZ04+NZ05+NZ06+NZ07+NZ08+NZ09+NZ10+NZ11
NZ=NZ+NZ12+NZ13+NZ14+NZ15+NZ16+NZ17+NZ18+NZ19+NZ20+NZ21
NZ=NZ+NZ22+NZ23+NZ24+NZ25
    GROUP 6. Body-fitted coordinates or grid distortion
BFC=T;NONORT=T
IG(1)=0
SATRUN(NECL)
READCO(GRID)
    GROUP 7. Variables stored, solved & named
SOLUTN(P1,Y,Y,Y,N,N,N)
SOLVE(U1,V1,W1)
SOLUTN(U1,Y,Y,N,Y,N,N)
SOLUTN(V1,Y,Y,N,Y,N,N)
SOLUTN(W1,Y,Y,N,Y,N,N)
SOLVE(H1,C1)
SOLVE(C2)
STORE(RHO1)
STORE(C3,C4,C5,C6,C7)
STORE(U2,V2,W2,C8,C9,C10,C11)
NAME(C4)=TEMP
NAME(C5)=CP
NAME(C8)=PH2O
NAME(C9)=TFAR
NAME(C10)=RHOE
NAME(C11)=SPAR
TURMOD(KEMODL)
STORE(ENUT)
KELIN=1

    GROUP 8. Terms (in differential equations) & devices
TERMS(H1,N,P,P,P,P,P)
    GROUP 9. Properties of the medium (or media)
  *
  ********************************************************************
  *********            USER DEFINED VARIABLES             ************
  ********************************************************************
  ***                                                              ***
  ***   NOTE:  These are the variables used to define this         ***
  ***          problem.                                            ***
  ***                                                              ***
  ***   COND1   --  k for mineral fiber (BTU/hr/ft/F)              ***
  ***   COND2   --  k for steel (BTU/hr/ft/F)                      ***
  ***   THICK1  --  Thickness of mineral fiber (in)                ***
  ***   THICK2  --  Thickness of steel (in)                        ***
  ***   TAMB    --  Temperature ambient (F)                        ***
  ***   TDYN    --  Temperature dynamometer (F)                    ***
  ***   TENG    --  Temperature engine (F)                         ***
  ***   EMDOT   --  Engine flow rate (lb/s)                        ***
  ***   DMDOT   --  Dynamometer flow rate (lb/s)                   ***
  ***   FMDOT   --  Fuel flow rate (lb/s)                          ***
  ***   PAMB    --  Pressure ambient (mm Hg)                       ***
  ***   TIG     --  Turbulence intensity inlet (-)                 ***
  ***   TID     --  Turbulence intensity dynamometer (-)           ***
  ***   TIE     --  Turbulence intensity engine (-)                ***
  ***   XKFCT1  --  K-loss factor inlet (-)                        ***
  ***   XKFCT2  --  K-loss factor dynamometer stack (-)            ***
  ***   XKFCT3  --  K-loss factor chimney (-)                      ***
  ***   AMF1     --  N2 mass fraction ambient (-)                     ***
  ***   AMF2     --  O2 mass fraction ambient (-)                     ***
  ***   AMF3     --  CO2 mass fraction ambient (-)                    ***
  ***   AMF4     --  H2O mass fraction ambient (-)                    ***
  ***   DMF1     --  N2 mass fraction dynamcmeter (-)                 ***
  ***   DMF2     --  O2 mass fraction dynamometer (-)                 ***
  ***   DMF3     --  CO2 mass fraction dynamometer (-)                ***
  ***   DMF4     --  H2O mass fraction dynamometer (-)                ***
  ***   EMF1     --  N2 mass fraction engine (-)                      ***
  ***   EMF2     --  O2 mass fraction engine (-)                      ***
  ***   EMF3     --  CO2 mass fraction engine (-)                     ***
  ***   EMF4     --  H2O mass fraction engine (-)                     ***
  ***   VCOM     --  Angle of momemtum at dyna plate (deg)            ***
  ***                  (90 deg for straight up)                       ***
  ***                                                                 ***
  *********************************************************************
  *
  *
  *********************************************************************
  *********                OTHER VARIABLES                ************
  *********************************************************************
  ***                                                                 ***
  ***   NOTE:  These are the variables used to define this          ***
  ***          problem.                                               ***
  ***                                                                 ***
  ***   XCON01  --  Converts in to m                                  ***
  ***   XCON02  --  Converts F to R                                   ***
  ***   XCON03  --  Converts R to K                                   ***
  ***   XCON04  --  Converts BTU/ft/h/R to J/s/m/K                    ***
  ***   XCON05  --  Converts lb to kg                                 ***
  ***   XCON06  --  Converts N/sq m to in H2O                         ***
  ***   XCON07  --  Converts m/s to ft/s                              ***
  ***   XCON08  --  Converts kg/cu m to lb/cu ft                      ***
  ***   XCON09  --  Converts in Hg to N/sq m                          ***
  ***   XCON10  --  Spare                                             ***
  ***   XCON11  --  Spare                                             ***
  ***   PTRAP   --  Pressure trap (N/sq m)                            ***
  ***   RGAS    --  Gas constant  (N-m/K/kgmol)                       ***
  ***   XMW1    --  Molecular weight N2 (kg/kgmol)                    ***
  ***   XMW2    --  Molecular weight O2 (kg/kgmol)                    ***
  ***   XMW3    --  Molecular weight CO2 (kg/kgmol)                   ***
  ***   XMW4    --  Molecular weight H2O (kg/kgmol)                   ***
  ***   DARSOR  --  Area of dynamometer plate source side (sq m)      ***
  ***   EARSOR  --  Area of engine plate source side (sq m)           ***
  ***   RHOAMB  --  Density ambient (kg/cu m)                         ***
  ***   RHODYN  --  Density dynamometer (kg/cu m)                     ***
  ***   RHOENG  --  Density engine (kg/cu m)                          ***
  ***   ENTHA   --  Enthalpy ambient (J/kg)                           ***
  ***   ENTHD   --  Enthalpy dynamometer (J/kg)                       ***
  ***   ENTHE   --  Enthalpy engine (J/kg)                            ***
  ***   GAPIN   --  Gap between inlet baffles (m)                     ***
  ***   GKE     --  Inlet KE (sq m/sq s)                              ***
  ***   GEP     --  Inlet EP (sq m/cu s)                              ***
  ***   DKE     --  Dynamometer KE (sq m/sq s)                        ***
  ***   DEP     --  Dynamometer EP (sq m/cu s)                        ***
  ***   EKE     --  Engine KE (sq m/sq s)                             ***
  ***   EEP     --  Engine EP (sq m/cu s)                             ***
  *********************************************************************
  *
REAL(TAMB,RGAS,TDYN,TENG)
REAL(DARSOR,EARSOR,RHOAMB,RHODYN,RHOENG)
REAL(AMF1,AMF2,AMF3,AMF4,DMF1,DMF2,DMF3,DMF4,EMF1,EMF2,EMF3,EMF4)
REAL(ENTHA,ENTHD,ENTHE,XMW1,XMW2,XMW3,XMW4,XMWA,XMWE)
REAL(COND1,THICK1,COND2,THICK2,PTRAP)
REAL(XCON01,XCON02,XCON03,XCON04,XCON05,XCON06)
REAL(XCON07,XCON08,XCON09,XCON10,XCON11)
REAL(EMDOT,DMDOT,FMDOT,PAMB)
REAL(GAPIN,TIG,TID,TIE,GKE,GEP,DKE,DEP,EKE,EEP)
REAL(XKFCT1,XKFCT2,XKFCT3,VCOM,SINO,COSO)
  *
  **********************************************************************
  *********                   USER SECTION                     *********
  **********************************************************************
  *
COND1=0.022
COND2=26.0
THICK1=2.0
THICK2=0.25
TAMB=77.0
TDYN=413.0
TENG=1200.0
EMDOT=11.2
DMDOT=14.0
FMDOT=0.2222222
PAMB=29.91
TIG=0.02
TID=0.10
TIE=0.15
XKFCT1=0.1
XKFCT2=0.1
XKFCT3=0.1
AMF1=0.7683
AMF2=0.2317
AMF3=0.0
AMF4=0.0
DMF1=0.7683
DMF2=0.2317
DMF3=0.0
DMF4=0.0
EMF1=0.7512
EMF2=0.1548
EMF3=0.069
EMF4=0.025
VCOM=45.0
  *
  **********************************************************************
  *
      conversions
XCON01=0.0254;          RG(31)=XCON01
XCON02=459.67;          RG(32)=XCON02
XCON03=5.0/9.0;         RG(33)=XCON03
XCON04=1.73073;         RG(34)=XCON04
XCON05=0.45359;         RG(35)=XCON05
XCON06=407.16/101325.0; RG(36)=XCON06
XCON07=3.2802;          RG(37)=XCON07
XCON08=0.062428;        RG(38)=XCON08
XCON09=101325.0/29.92;  RG(39)=XCON09

COND1=COND1*XCON04
COND2=COND2*XCON04
```

```
THICK1=THICK1*XCON01
THICK2=THICK2*XCON01
TAMB=(TAMB+XCON02)*XCON03
TDYN=(TDYN+XCON02)*XCON03
TENG=(TENG+XCON02)*XCON03
EMDOT=EMDOT*XCON05
DMDOT=DMDOT*XCON05
FMDOT=FMDOT*XCON05
PAMB=PAMB*XCON09
      density info
PTRAP=0.05
RG(29)=PTRAP
RGAS=8314.32
RG( 1)=AMF1
RG( 2)=AMF2
RG( 3)=AMF3
RG( 4)=AMF4
RG( 5)=DMF1
RG( 6)=DMF2
RG( 7)=DMF3
RG( 8)=DMF4
RG( 9)=EMF1
RG(10)=EMF2
RG(11)=EMF3
RG(12)=EMF4
RG(13)=TAMB
RG(14)=TDYN
RG(15)=TENG
XMW1=28.1608;           RG(21)=XMW1
XMW2=31.9988;           RG(22)=XMW2
XMW3=44.0100;           RG(23)=XMW3
XMW4=18.0152;           RG(24)=XMW4
RG(25)=RGAS
      area calculation dyna
DARSOR=DYNAW*DYNAL*XCON01*XCON01
      area calculation engine
EARSOR=PI*(DENGI/2.*XCON01)*(DENGI/2.*XCON01)
RG(801)=DARSOR
RG(802)=EARSOR
      density calculation
XMWA=1.0/(AMF1/XMW1+AMF2/XMW2+AMF3/XMW3+AMF4/XMW4)
XMWE=1.0/(EMF1/XMW1+EMF2/XMW2+EMF3/XMW3+EMF4/XMW4)
RHOAMB=PAMB*XMWA/(RGAS*TAMB)
RG(701)=RHOAMB
RHODYN=PAMB*XMWA/(RGAS*TDYN)
RHOENG=PAMB*XMWE/(RGAS*TENG)
      run satlit for enthalpy calculation
IG(1)=3
SATRUN(NECL)
      other stuff
ENTHA=RG(16)
ENTHD=RG(17)
ENTHE=RG(18)
PRESS0=PAMB
RHO1=GRND
DRH1DP=GRND
      turbulence  (assume 1 m/s velocity)
GAPIN=XINL/14.0*XCON01
GKE=0.5*(1.0*TIG)**2
GEP=0.164*GKE**1.5/(0.09*GAPIN)
```

```
DKE=0.5*((DMDOT/DARSOR/RHODYN)*TID)**2
DEP=0.164*DKE**1.5/(0.09*DARSOR**0.5)
EKE=0.5*((EMDOT/EARSOR/RHOENG)*TIE)**2
EEP=0.164*EKE**1.5/(0.09*EARSOR**0.5)
      angle calculation
VCOM=VCOM*PI/180.
SINO=VCOM
SINO=SINO-(VCOM**3)/(3.*2.)
SINO=SINO+(VCOM**5)/(5.*4.*3.*2.)
SINO=SINO-(VCOM**7)/(7.*6.*5.*4.*3.*2.)
COSO=1.-(VCOM**2)/2.
COSO=COSO+(VCOM**4)/(4.*3.*2.)
COSO=COSO-(VCOM**6)/(6.*5.*4.*3.*2.)
COSO=COSO+(VCOM**8)/(8.*7.*6.*5.*4.*3.*2.)

    GROUP 10. Inter-phase-transfer processes and properties
  *
  *******************************************************************
  *********                     INDEX                       *********
  *******************************************************************
  ***                                                             ***
  ***   The following variables are used as an index to define    ***
  ***   the extent of blockages in the X, Y, & Z directions.      ***
  ***   This was done because a user may change the number of     ***
  ***   regions in each direction.  The user will then make the   ***
  ***   appropriate changes in this section and then no further   ***
  ***   changes will be required below this section.  The         ***
  ***   nomenclature for the variables below is as follows:       ***
  ***   1.)  The first letter represents direction (ie I for X),  ***
  ***   2.)  Middle two letters represents the blockage name, &   ***
  ***   3.)  Last letter represents first or last.                ***
  ***                                                             ***
  *******************************************************************
  *
INTEGER(IFWF,IFWL,JFWF,JFWL,KFWF,KFWL)
INTEGER(ICAF,ICAL,JCAF,JCAL,KCAF,KCAL)
INTEGER(ID1F,ID1L,JD1F,JD1L,KD1F,KD1L)
INTEGER(ID2F,ID2L,JD2F,JD2L,KD2F,KD2L)
INTEGER(ID3F,ID3L,JD3F,JD3L,KD3F,KD3L)
INTEGER(ID4F,ID4L,JD4F,JD4L,KD4F,KD4L)
INTEGER(ID5F,ID5L,JD5F,JD5L,KD5F,KD5L)
INTEGER(ID6F,ID6L,JD6F,JD6L,KD6F,KD6L)
INTEGER(ID7F,ID7L,JD7F,JD7L,KD7F,KD7L)
INTEGER(ID8F,ID8L,JD8F,JD8L,KD8F,KD8L)
INTEGER(ID9F,ID9L,JD9F,JD9L,KD9F,KD9L)
INTEGER(ID0F,ID0L,JD0F,JD0L,KD0F,KD0L)
INTEGER(IESF,IESL,JESF,JESL,KESF,KESL)
INTEGER(IDEF,IDEL,JDEF,JDEL,KDEF,KDEL)
INTEGER(IPLF,IPLL,JPLF,JPLL,KPLF,KPLL)
INTEGER(IEGF,IEGL,JEGF,JEGL,KEGF,KEGL)
INTEGER(IA1F,IA1L,JA1F,JA1L,KA1F,KA1L)
INTEGER(IA2F,IA2L,JA2F,JA2L,KA2F,KA2L)
INTEGER(IW1F,IW1L,JW1F,JW1L,KW1F,KW1L)
INTEGER(IW2F,IW2L,JW2F,JW2L,KW2F,KW2L)
INTEGER(IW3F,IW3L,JW3F,JW3L,KW3F,KW3L)
INTEGER(IW4F,IW4L,JW4F,JW4L,KW4F,KW4L)
INTEGER(IIN,JDP,KEP)
INTEGER(IDPF,IDPL,KDPF,KDPL)
INTEGER(IEPF,IEPL,JEPF,JEPL)
```

```
    inlet cutoff
IIN=IG(61)
   @@@@@@@  SPECIFY WHEN BAFFLES EXTEND INTO DOMAIN  @@@@@@@
 IFWF=IXAF01;             IFWL=IIN
 JFWF=IYAF01;             JFWL=IYAL10
 KFWF=IZF01;              KFWL=IZL01-1
   @@@@@@@  SPECIFY WHEN BAFFLES DO NOT EXTEND INTO DOMAIN  @@@@@@@
 IFWL=IIN

    cart
ICAF=IXAF03;            ICAL=IXAL11
JCAF=IYAF02;            JCAL=IYAL02
KCAF=IZF03;             KCAL=IZL13

    dynamometer front wall (lower section)
ID1F=IXAF05;            ID1L=IXAL09
JD1F=IYAF03;            JD1L=IYAL03
KD1F=IZF05;             KD1L=IZL06
    dynamometer front wall (mid-right section)
ID2F=IXAF05;            ID2L=IXAL06
JD2F=IYAF04;            JD2L=IYAL04
KD2F=IZF05;             KD2L=IZL06
    dynamometer front wall (mid-left section)
ID3F=IXAF08;            ID3L=IXAL09
JD3F=IYAF04;            JD3L=IYAL04
KD3F=IZF05;             KD3L=IZL06
    dynamometer front wall (top section)
ID4F=IXAF05;            ID4L=IXAL09
JD4F=IYAF05;            JD4L=IYAL06
KD4F=IZF05;             KD4L=IZL06
    dynamometer back wall (lower section)
ID5F=IXAF05;            ID5L=IXAL09
JD5F=IYAF03;            JD5L=IYAL03
KD5F=IZF09;             KD5L=IZL09
    dynamometer back wall (mid-right section)
ID6F=IXAF05;            ID6L=IXAL06
JD6F=IYAF04;            JD6L=IYAL04
KD6F=IZF09;             KD6L=IZL09
    dynamometer back wall (mid-left section)
ID7F=IXAF08;            ID7L=IXAL09
JD7F=IYAF04;            JD7L=IYAL04
KD7F=IZF09;             KD7L=IZL09
    dynamometer back wall (top section)
ID8F=IXAF05;            ID8L=IXAL09
JD8F=IYAF05;            JD8L=IYAL06
KD8F=IZF09;             KD8L=IZL09
    dynamometer side wall (right)
ID9F=IXAF05;            ID9L=IXAL05
JD9F=IYAF03;            JD9L=IYAL06
KD9F=IZF07;             KD9L=IZL08
    dynamometer side wall (left)
ID0F=IXAF09;            ID0L=IXAL09
JD0F=IYAF03;            JD0L=IYAL06
KD0F=IZF07;             KD0L=IZL08
    dynamometer plate
IDPF=IXAF06;            IDPL=IXAL08
JDP=IYAL04+2
KDPF=IZF07;             KDPL=IZL08

IG(701)=JDP
IG(702)=IDPF;           IG(703)=IDPL
IG(704)=KDPF;           IG(705)=KDPL


    exhaust skirt
   @@@@@@@  SPECIFY FOR EXHAUST SKIRT  @@@@@@@
 IESF=IXAF04;            IESL=IXAL10
 JESF=IYAF06;            JESL=IYAL08
 KESF=IZF04;             KESL=IZL10

    dynamometer exhaust
IDEF=IXAF06;            IDEL=IXAL08
JDEF=IYAF08;            JDEL=IYAL10
KDEF=IZF06;             KDEL=IZL07

    plate    (WARNING:  conpor sec does NONgeneralized stair step)
IPLF=IXAF03;            IPLL=IXAL11
JPLF=IYAF03;            JPLL=IYAL06
KPLF=IZF12;             KPLL=IZF12

    engine
IEGF=IXBF04;            IEGL=IXBL05
JEGF=IYBF04;            JEGL=IYBL05
KEGF=IZF13;             KEGL=IZL15
    engine plate
IEPF=IEGF;              IEPL=IEGL
JEPF=JEGF;              JEPL=JEGL
KEP=IZF14

IG(711)=KEP
IG(712)=IEPF;IG(713)=IEPL
IG(714)=JEPF;IG(715)=JEPL

    augmenter tube (in building)
IA1F=IXCF04;            IA1L=IXCL05
JA1F=IYCF04;            JA1L=IYCL05
KA1F=IZF17;             KA1L=IZL21
    augmenter tube (in chimney)
IA2F=IXDF02;            IA2L=IXDL03
JA2F=IYDF02;            JA2L=IYDL03
KA2F=IZF23;             KA2L=IZL23

    wall (lower section)
IW1F=IXDF01;            IW1L=IXDL04
JW1F=IYDF01;            JW1L=IYDL01
KW1F=IZF22;             KW1L=IZL22
    wall (mid-right section)
IW2F=IXDF01;            IW2L=IXDL01
JW2F=IYDF02;            JW2L=IYDL03
KW2F=IZF22;             KW2L=IZL22
    wall (mid-left section)
IW3F=IXDF04;            IW3L=IXDL04
JW3F=IYDF02;            JW3L=IYDL03
KW3F=IZF22;             KW3L=IZL22
    wall (top section)
IW4F=IXDF01;            IW4L=IXDL04
JW4F=IYDF04;            JW4L=IYDL04
KW4F=IZF22;             KW4L=IZL22

    GROUP 11. Initialization of variable or porosity fields
    inlet wall protrusion
   &&&LG&&&  ACTIVATE FOR BAFFLES EXTENDING INTO DOMAIN  &&&4T&&&
 CONPOR(0.0,CELL,  IFWF,-IFWL, JFWF, JFWL, KFWF, KFWL)
 CONPOR(0.0,EAST, -IFWL,-IFWL, JFWF, JFWL, KFWL, KFWL+1)

    cart
CONPOR(0.0,CELL,  ICAF, ICAL,-JCAF,-JCAL, KCAF, KCAL)

    dynamometer exhaust
CONPOR(0.0,LOW,   IDEF, IDEL, JDEF, JDEL,-KDEF,-KDEF)
CONPOR(0.0,HIGH,  IDEF, IDEL, JDEF, JDEL,-KDEL,-KDEL)
CONPOR(0.0,WEST, -IDEF,-IDEF, JDEF, JDEL, KDEF, KDEL)
CONPOR(0.0,EAST, -IDEL,-IDEL, JDEF, JDEL, KDEF, KDEL)

    exhaust skirt
   &&&LG&&&  ACTIVATE FOR EXHAUST SKIRT  &&&1T&&&
 CONPOR(0.0,LOW,   IESF, IESL, JESF, JESL,-KESF,-KESF)
 CONPOR(0.0,HIGH,  IESF, IESL, JESF, JESL,-KESL,-KESL)
 CONPOR(0.0,WEST, -IESF,-IESF, JESF, JESL, KESF, KESL)
 CONPOR(0.0,EAST, -IESL,-IESL, JESF, JESL, KESF, KESL)

 CONPOR(0.0,NORTH, IESF,   IDEF-1,-JESL,-JESL, KESF,   KESL)
 CONPOR(0.0,NORTH, IDEL+1, IESL,  -JESL,-JESL, KESF,   KESL)
 CONPOR(0.0,NORTH, IDEF,   IDEL,  -JESL,-JESL, KESF,   KDEF-1)
 CONPOR(0.0,NORTH, IDEF,   IDEL,  -JESL,-JESL, KDEL+1, KESL)

    dynamometer
CONPOR(0.0,CELL, -ID1F,-ID1L, JD1F, JD1L,-KD1F,-KD1L)
CONPOR(0.0,CELL, -ID2F, ID2L, JD2F, JD2L,-KD2F,-KD2L)
CONPOR(0.0,CELL,  ID3F,-ID3L, JD3F, JD3L,-KD3F,-KD3L)
CONPOR(0.0,CELL, -ID4F,-ID4L, JD4F, JD4L,-KD4F,-KD4L)
CONPOR(0.0,CELL, -ID5F,-ID5L, JD5F, JD5L,-KD5F,-KD5L)
CONPOR(0.0,CELL, -ID6F, ID6L, JD6F, JD6L,-KD6F,-KD6L)
CONPOR(0.0,CELL,  ID7F,-ID7L, JD7F, JD7L,-KD7F,-KD7L)
CONPOR(0.0,CELL, -ID8F,-ID8L, JD8F, JD8L,-KD8F,-KD8L)
CONPOR(0.0,CELL, -ID9F,-ID9F, JD9F, JD9L, KD9F, KD9L)
CONPOR(0.0,CELL, -ID0L,-ID0L, JD0F, JD0L, KD0F, KD0L)

    dynamometer plate
CONPOR(0.0,NORTH, IDPF, IDPL, JDP, JDP, KDPF, KDPL)

    plate  (WARNING:  last 4 hardwired)
CONPOR(0.0,LOW,   IPLF, IPLL, JPLF, JPLL,-KPLF,-KPLF)
CONPOR(0.0,LOW,     11,   28,   26,   27,-KPLF,-KPLF)
CONPOR(0.0,LOW,     12,   27,   28,   28,-KPLF,-KPLF)
CONPOR(0.0,LOW,     13,   26,   29,   29,-KPLF,-KPLF)
CONPOR(0.0,LOW,     14,   25,   30,   30,-KPLF,-KPLF)

    engine
CONPOR(0.0,SOUTH, IEGF, IEGL,-JEGF,-JEGF, KEGF, KEGL)
CONPOR(0.0,NORTH, IEGF, IEGL,-JEGL,-JEGL, KEGF, KEGL)
CONPOR(0.0,WEST, -IEGF,-IEGF, JEGF, JEGL, KEGF, KEGL)
CONPOR(0.0,EAST, -IEGL,-IEGL, JEGF, JEGL, KEGF, KEGL)

    engine plate
CONPOR(0.0,HIGH,  IEPF, IEPL, JEPF, JEPL, KEP, KEP)

    augmenter tube (in building)
CONPOR(0.0,SOUTH, IA1F, IA1L,-JA1F,-JA1F, KA1F, KA1L)
CONPOR(0.0,NORTH, IA1F, IA1L,-JA1L,-JA1L, KA1F, KA1L)
CONPOR(0.0,WEST, -IA1F,-IA1F, JA1F, JA1L, KA1F, KA1L)
CONPOR(0.0,EAST, -IA1L,-IA1L, JA1F, JA1L, KA1F, KA1L)

    end wall
CONPOR(0.0,CELL,  IW1F, IW1L, JW1F,-JW1L,-KW1F,-KW1L)
CONPOR(0.0,CELL,  IW2F,-IW2L, JW2F, JW2L,-KW2F,-KW2L)
CONPOR(0.0,CELL, -IW3F, IW3L, JW3F, JW3L,-KW3F,-KW3L)
CONPOR(0.0,CELL,  IW4F, IW4L,-JW4F, JW4L,-KW4F,-KW4L)

    augmenter tube (in chimney)
CONPOR(0.0,SOUTH, IA2F, IA2L,-JA2F,-JA2F, KA2F, KA2L)
CONPOR(0.0,NORTH, IA2F, IA2L,-JA2L,-JA2L, KA2F, KA2L)
CONPOR(0.0,WEST, -IA2F,-IA2F, JA2F, JA2L, KA2F, KA2L)
CONPOR(0.0,EAST, -IA2L,-IA2L, JA2F, JA2L, KA2F, KA2L)

    init all
FIINIT(H1)=ENTHA
FIINIT(TEMP)=TAMB
FIINIT(RHO1)=RHOAMB
FIINIT(C3)=1.0
FIINIT(KE)=GKE
FIINIT(EP)=GEP
    init duct
PATCH(INITA,INIVAL,IDPF,IDPL,JDP+1,JD4L,KDPF,KDPL,1,1)
INIT (INITA,H1,0.0,ENTHD)
INIT (INITA,TEMP,0.0,TDYN)
INIT (INITA,RHO1,0.0,RHODYN)
INIT (INITA,C2,0.0,1.0)
INIT (INITA,KE,0.0,DKE)
INIT (INITA,EP,0.0,DEP)
INIT (INITA,V1,0.0,DMDOT/DARSOR/RHODYN)
PATCH(INITB,INIVAL,IDEF,IDEL,JD4L+1,JDEL,KDEF,KDEL,1,1)
INIT (INITB,H1,0.0,ENTHD)
INIT (INITB,TEMP,0.0,TDYN)
INIT (INITB,RHO1,0.0,RHODYN)
INIT (INITB,C2,0.0,1.0)
INIT (INITB,KE,0.0,DKE)
INIT (INITB,EP,0.0,DEP)
INIT (INITB,V1,0.0,DMDOT/DARSOR/RHODYN)
    init eng
PATCH(INITC,INIVAL,IEGF,IEGL,JEGF,JEGL,KEP+1,KA1F-1,1,1)
INIT (INITC,H1,0.0,ENTHE)
INIT (INITC,TEMP,0.0,TENG)
INIT (INITC,RHO1,0.0,RHOENG)
INIT (INITC,C1,0.0,1.0)
INIT (INITC,KE,0.0,EKE)
INIT (INITC,EP,0.0,EEP)
INIT (INITC,W1,0.0,EMDOT/EARSOR/RHOENG)
    init aug
PATCH(INITD,INIVAL,IA1F,IA1L,JA1F,JA1L,KA1F,KA2L,1,1)
INIT (INITD,H1,0.0,ENTHE)
INIT (INITD,TEMP,0.0,TENG)
INIT (INITD,C1,0.0,1.0)
INIT (INITD,KE,0.0,EKE)
INIT (INITD,EP,0.0,EEP)
INIT (INITD,W1,0.0,EMDOT/EARSOR/RHOENG)

    GROUP 12. Convection and diffusion adjustments
    GROUP 13. Boundary conditions and special sources
    front wall
```

```
PATCH(XWALL01,LWALL,IFWL+1,NX,1,NY,1,1,1,1)
COVAL(XWALL01,U1,GRND2,0.0)
COVAL(XWALL01,V1,GRND2,0.0)
COVAL(XWALL01,KE,GRND2,GRND2)
COVAL(XWALL01,EP,GRND2,GRND2)
    top wall
PATCH(XWALL02,NWALL,1,NX,NY,NY,IZF01,KDEF-1,1,1)
COVAL(XWALL02,U1,GRND2,0.0)
COVAL(XWALL02,W1,GRND2,0.0)
COVAL(XWALL02,KE,GRND2,GRND2)
COVAL(XWALL02,EP,GRND2,GRND2)
PATCH(XWALL03,NWALL,1,IDEF-1,NY,NY,KDEF,KDEL,1,1)
COVAL(XWALL03,U1,GRND2,0.0)
COVAL(XWALL03,W1,GRND2,0.0)
COVAL(XWALL03,KE,GRND2,GRND2)
COVAL(XWALL03,EP,GRND2,GRND2)
PATCH(XWALL04,NWALL,IDEL+1,NX,NY,NY,KDEF,KDEL,1,1)
COVAL(XWALL04,U1,GRND2,0.0)
COVAL(XWALL04,W1,GRND2,0.0)
COVAL(XWALL04,KE,GRND2,GRND2)
COVAL(XWALL04,EP,GRND2,GRND2)
PATCH(XWALL05,NWALL,1,NX,NY,NY,KDEL+1,KW1F-1,1,1)
COVAL(XWALL05,U1,GRND2,0.0)
COVAL(XWALL05,W1,GRND2,0.0)
COVAL(XWALL05,KE,GRND2,GRND2)
COVAL(XWALL05,EP,GRND2,GRND2)
   bottom wall
PATCH(XWALL06,SWALL,1,NX,1,1,1,KW1F-1,1,1)
COVAL(XWALL06,U1,GRND2,0.0)
COVAL(XWALL06,W1,GRND2,0.0)
COVAL(XWALL06,KE,GRND2,GRND2)
COVAL(XWALL06,EP,GRND2,GRND2)
   side to block wall
PATCH(XWALL07,WWALL,1,1,1,NY,1,KW1F-1,1,1)
COVAL(XWALL07,V1,GRND2,0.0)
COVAL(XWALL07,W1,GRND2,0.0)
COVAL(XWALL07,KE,GRND2,GRND2)
COVAL(XWALL07,EP,GRND2,GRND2)
PATCH(XWALL08,EWALL,NX,NX,1,NY,1,KW1F-1,1,1)
COVAL(XWALL08,V1,GRND2,0.0)
COVAL(XWALL08,W1,GRND2,0.0)
COVAL(XWALL08,KE,GRND2,GRND2)
COVAL(XWALL08,EP,GRND2,GRND2)
    chimney wall
PATCH(XWALL09,NWALL,1,NX,NY,NY,KA2L+1,NZ,1,1)
COVAL(XWALL09,U1,GRND2,0.0)
COVAL(XWALL09,W1,GRND2,0.0)
COVAL(XWALL09,KE,GRND2,GRND2)
COVAL(XWALL09,EP,GRND2,GRND2)
PATCH(XWALL10,SWALL,1,NX,1,1,KW1L+1,NZ,1,1)
COVAL(XWALL10,U1,GRND2,0.0)
COVAL(XWALL10,W1,GRND2,0.0)
COVAL(XWALL10,KE,GRND2,GRND2)
COVAL(XWALL10,EP,GRND2,GRND2)
PATCH(XWALL11,WWALL,1,1,1,NY,KW1L+1,NZ,1,1)
COVAL(XWALL11,V1,GRND2,0.0)
COVAL(XWALL11,W1,GRND2,0.0)
COVAL(XWALL11,KE,GRND2,GRND2)
COVAL(XWALL11,EP,GRND2,GRND2)
PATCH(XWALL12,EWALL,NX,NX,1,NY,KW1L+1,NZ,1,1)
```

```
COVAL(XWALL12,V1,GRND2,0.0)
COVAL(XWALL12,W1,GRND2,0.0)
COVAL(XWALL12,KE,GRND2,GRND2)
COVAL(XWALL12,EP,GRND2,GRND2)
    front opening
   &&&LG&&&  ACTIVATE FOR BAFFLES EXTENDING INTO DOMAIN  &&&4T&&&
 PATCH(XOPEN1,LOW,1,IFWL,1,NY,KFWL+1,KFWL+1,1,1)
   &&&LG&&&  ACTIVATE FOR BAFFLES NOT EXTENDING INTO DOMAIN  &&&4F&&&
   PATCH(XOPEN1,LOW,1,IFWL,1,NY,1,1,1,1)
COVAL(XOPEN1,P1,GRND7,0.0)
COVAL(XOPEN1,W1,ONLYMS,GRND7)
COVAL(XOPEN1,H1,ONLYMS,ENTHA)
COVAL(XOPEN1,KE,ONLYMS,GKE)
COVAL(XOPEN1,EP,ONLYMS,GEP)
COVAL(XOPEN1,UCRT,ONLYMS,XKFCT1)
    dynamometer exhaust
PATCH(XOPEN2,NORTH,IDEF,IDEL,NY,NY,KDEF,KDEL,1,1)
COVAL(XOPEN2,P1,GRND7,0.0)
COVAL(XOPEN2,V1,ONLYMS,GRND7)
COVAL(XOPEN2,H1,ONLYMS,ENTHA)
COVAL(XOPEN2,UCRT,ONLYMS,XKFCT2)
    chimney exhaust
PATCH(XOPEN3,HIGH,1,NX,1,NY,NZ,NZ,1,1)
COVAL(XOPEN3,P1,GRND7,0.0)
COVAL(XOPEN3,W1,ONLYMS,SAME)
COVAL(XOPEN3,H1,ONLYMS,ENTHA)
COVAL(XOPEN3,UCRT,ONLYMS,XKFCT3)
    dynamometer mdot sink
PATCH(XDYNOIN,NORTH,IDPF,IDPL,JDP,JDP,KDPF,KDPL,1,1)
COVAL(XDYNOIN,P1,FIXFLU,GRND9)
    dynamometer mdot source
PATCH(XDYNOUT,SOUTH,IDPF,IDPL,JDP+1,JDP+1,KDPF,KDPL,1,1)
COVAL(XDYNOUT,P1,FIXFLU,GRND9)
COVAL(XDYNOUT,V1,ONLYMS,DMDOT/DARSOR/RHODYN*SINO)
COVAL(XDYNOUT,U1,ONLYMS,DMDOT/DARSOR/RHODYN*COSO)
COVAL(XDYNOUT,H1,ONLYMS,ENTHD)
COVAL(XDYNOUT,C2,ONLYMS,1.0)
COVAL(XDYNOUT,KE,ONLYMS,DKE)
COVAL(XDYNOUT,EP,ONLYMS,DEP)
RG(803)=DMDOT/DARSOR
    engine mdot sink
PATCH(XENGIN,HIGH,IEGF,IEGL,JEGF,JEGL,KEP,KEP,1,1)
COVAL(XENGIN,P1,FIXFLU,GRND10)
RG(804)=(EMDOT-FMDOT)/EARSOR
    engine mdot source
PATCH(XENGOUT,LOW,IEGF,IEGL,JEGF,JEGL,KEP+1,KEP+1,1,1)
COVAL(XENGOUT,P1,FIXFLU,GRND10)
COVAL(XENGOUT,W1,ONLYMS,EMDOT/EARSOR/RHOENG)
COVAL(XENGOUT,H1,ONLYMS,ENTHE)
COVAL(XENGOUT,C1,ONLYMS,1.0)
COVAL(XENGOUT,KE,ONLYMS,EKE)
COVAL(XENGOUT,EP,ONLYMS,EEP)
RG(805)=EMDOT/EARSOR
    heat transfer augmenter tube (in building)
PATCH(HEATTR1E,EWALL,IA1F-1,IA1F,JA1F,JA1L,KA1F,KA1L,1,1)
COVAL(HEATTR1E,H1,GRND8,GRND8);COVAL(HEATTR1E,UCRT,COND1,THICK1)
PATCH(HEATTR1W,WWALL,IA1L,IA1L+1,JA1F,JA1L,KA1F,KA1L,1,1)
COVAL(HEATTR1W,H1,GRND8,GRND8);COVAL(HEATTR1W,UCRT,COND1,THICK1)
PATCH(HEATTR1N,NWALL,IA1F,IA1L,JA1F-1,JA1F,KA1F,KA1L,1,1)
COVAL(HEATTR1N,H1,GRND8,GRND8);COVAL(HEATTR1N,UCRT,COND1,THICK1)
```

```
PATCH(HEATTR1S,SWALL,IA1F,IA1L,JA1L,JA1L+1,KA1F,KA1L,1,1)
COVAL(HEATTR1S,H1,GRND8,GRND8);COVAL(HEATTR1S,UCRT,COND1,THICK1)
    heat transfer augmenter tube (in chimney)
PATCH(HEATTR2E,EWALL,IA2F-1,IA2F,JA2F,JA2L,KA2F,KA2L,1,1)
COVAL(HEATTR2E,H1,GRND8,GRND8);COVAL(HEATTR2E,UCRT,COND2,THICK2)
PATCH(HEATTR2W,WWALL,IA2L,IA2L+1,JA2F,JA2L,KA2F,KA2L,1,1)
COVAL(HEATTR2W,H1,GRND8,GRND8);COVAL(HEATTR2W,UCRT,COND2,THICK2)
PATCH(HEATTR2N,NWALL,IA2F,IA2L,JA2F-1,JA2F,KA2F,KA2L,1,1)
COVAL(HEATTR2N,H1,GRND8,GRND8);COVAL(HEATTR2N,UCRT,COND2,THICK2)
PATCH(HEATTR2S,SWALL,IA2F,IA2L,JA2L,JA2L+1,KA2F,KA2L,1,1)
COVAL(HEATTR2S,H1,GRND8,GRND8);COVAL(HEATTR2S,UCRT,COND2,THICK2)

    GROUP 14. Downstream pressure for PARAB=.TRUE.
    GROUP 15. Termination of sweeps
FSWEEP=2
LSWEEP=2500
  *
  **********************************************************************
  *********                 USER CONTROLS                     *********
  **********************************************************************
  ***                                                                ***
  ***   The following integer arrays are described below.            ***
  ***                                                                ***
  ***                                                                ***
  ***   IG(901)  --  Frequency of ground printout on wall heat       ***
  ***                transfer.                                       ***
  ***   IG(902)  --  Frequency of restart files and English unit     ***
  ***                calculation.                                    ***
  ***   IG(999)  --  Set to 1 to stop run on first sweep.            ***
  ***   IG( 38)  --  Set to 1 for first set of spot value info.      ***
  ***   IG( 39)  --  Set to 1 for second set of spot value info.     ***
  ***   IG( 40)  --  Set to 1 for third set of spot value info.      ***
  ***   IG( 41)  --  Set to 1 for additional heat transfer info.     ***
  ***                                                                ***
  **********************************************************************
IG(901)=50
IG(902)=100
IG(999)=0
    GROUP 16. Termination of iterations
LITER(P1)=30
ENDIT(P1)=1.0E-3
ENDIT(H1)=1.0E-2
RESREF(P1)=1.0E-8
RESREF(U1)=1.0E-8
RESREF(V1)=1.0E-8
RESREF(W1)=1.0E-8
RESREF(H1)=1.0E-8
RESREF(C1)=1.0E-8
RESREF(C2)=1.0E-8
RESREF(KE)=1.0E-8
RESREF(EP)=1.0E-8
    GROUP 17. Under-relaxation devices
RELAX(P1,LINRLX,0.1)
RELAX(KE,LINRLX,0.1)
RELAX(EP,LINRLX,0.1)
RELAX(U1,FALSDT,0.00025)
RELAX(V1,FALSDT,0.00025)
RELAX(W1,FALSDT,0.00025)
RELAX(H1,FALSDT,0.0005)
RELAX(C1,FALSDT,0.0005)
RELAX(C2,FALSDT,0.0005)
    GROUP 18. Limits on variables or increments to them
VARMAX(C1)=1.00;VARMIN(C1)=1.0E-10
VARMAX(C2)=1.00;VARMIN(C2)=1.0E-10
VARMAX(ENUT)=10000000.*ENUL
    GROUP 19. Data communicated by satellite to GROUND
    GROUP 20. Preliminary print-out
    GROUP 21. Print-out of variables
OUTPUT(P1,Y,Y,N,Y,Y,Y)
OUTPUT(U1,Y,N,N,Y,Y,Y)
OUTPUT(V1,Y,N,N,Y,Y,Y)
OUTPUT(W1,Y,N,N,Y,Y,Y)
OUTPUT(KE,N,N,N,Y,Y,Y)
OUTPUT(EP,N,N,N,Y,Y,Y)
OUTPUT(H1,N,N,N,Y,Y,Y)
OUTPUT(C1,N,N,N,Y,Y,Y)
OUTPUT(C2,N,N,N,Y,Y,Y)
OUTPUT(C3,N,N,N,N,N,N)
OUTPUT(TEMP,Y,N,N,N,N,N)
OUTPUT(CP,N,N,N,N,N,N)
OUTPUT(C6,N,N,N,N,N,N)
OUTPUT(C7,N,N,N,N,N,N)
OUTPUT(U2,N,N,N,N,N,N)
OUTPUT(V2,N,N,N,N,N,N)
OUTPUT(W2,N,N,N,N,N,N)
OUTPUT(PH2O,N,N,N,N,N,N)
OUTPUT(TFAR,N,N,N,N,N,N)
OUTPUT(RHOE,N,N,N,N,N,N)
OUTPUT(SPAR,N,N,N,N,N,N)
OUTPUT(RHO1,Y,N,N,N,N,N)
OUTPUT(UCRT,N,N,N,N,N,N)
OUTPUT(VCRT,N,N,N,N,N,N)
OUTPUT(WCRT,N,N,N,N,N,N)
    GROUP 22. Spot-value print-out
IXMON =19;IYMON = 6;IZMON =11
IXMON1=13;IYMON1= 8;IZMON1=15
IXMON2=19;IYMON2=16;IZMON2=26
IXMON3=16;IYMON3=13;IZMON3=39
IXMON4=19;IYMON4=22;IZMON4=44
IXMON5=10;IYMON5=11;IZMON5=59
IXMON6=17;IYMON6=13;IZMON6=71
IXMON7=17;IYMON7=17;IZMON7=71
IXMON8=17;IYMON8=20;IZMON8=71
IXMON9=19;IYMON9=16;IZMON9=73
IG(11)=IXMON1;IG(12)=IYMON1;IG(13)=IZMON1
IG(14)=IXMON2;IG(15)=IYMON2;IG(16)=IZMON2
IG(17)=IXMON3;IG(18)=IYMON3;IG(19)=IZMON3
IG(20)=IXMON4;IG(21)=IYMON4;IG(22)=IZMON4
IG(23)=IXMON5;IG(24)=IYMON5;IG(25)=IZMON5
IG(26)=IXMON6;IG(27)=IYMON6;IG(28)=IZMON6
IG(29)=IXMON7;IG(30)=IYMON7;IG(31)=IZMON7
IG(32)=IXMON8;IG(33)=IYMON8;IG(34)=IZMON8
IG(35)=IXMON9;IG(36)=IYMON9;IG(37)=IZMON9
IG(38)=1
IG(39)=1
IG(40)=0
IG(41)=0
    GROUP 23. Field print-out and plot control
YZPR=T;IXPRF=19;IXPRL=19
TSTSWP=5;        NPRMON=5
```

```
NPRINT=LSWEEP;   IPLTL=LSWEEP;    ITABL=3
ABSIZ=.8;        ORSIZ=.8;        NUMCLS=10
NPLT=25
    GROUP 24. Dumps for restarts
  RESTRT(ALL);NAMFI=INXS
RESTRT(ALL);NAMFI=IIII
STOP
```

APPENDIX C

```
C THIS IS THE MAIN PROGRAM OF THE SATELLITE
      PROGRAM MAIN
C FILE NAME satlit.f 09/27/87
C
C   (C) COPYRIGHT 1984, LAST REVISION 1987.
C   CONÇENTRATION HEAT AND MOMENTUM LTD. ALL RIGHTS RESERVED.
C   This subroutine and the remainder of the PHOENICS code are
C   proprietary software owned by Concentration Heat and Momentum
C   Limited, 40 High Street, Wimbledon, London SW19 5AU, England.
C
      LOGICAL TALK,RUN,LVAL
      EXTERNAL WAYOUT
C
C 1   Set dimensions of blank-COMMON arrays here. WARNING: the
C     corresponding blank-COMMON arrays in subroutine SATLIT must
C     have the same dimensions.
      PARAMETER (NXFD=1000,NYFD=1000,NZFD=1000,NTFD=10000)
      PARAMETER (NTCVD=25000,NBFCD=500000)
      COMMON TCVDA(NTCVD),XFRAC(NXFD),YFRAC(NYFD),ZFRAC(NZFD),
     1TFRAC(NTFD),BFCS(NBFCD)
C
C 2   Set dimensions of PATCH-name array and the instruction-stack
C     array here. The dimension of the array NLN must be the same
C     as that of STACK. WARNING: the array NAMPAT in the MAIN
C     program of EARTH (see GROUND) must have the same dimension.
C     These are specified by the parameters npatd and nld, set below.
      PARAMETER (NPATD=1000,NLD=2000)
      COMMON/NPAT/NAMPAT(NPATD)/NSTCK/STACK(NLD)/LINENO/NLN(NLD)
      CHARACTER NAMPAT*8,STACK*72
      COMMON/CNFG/CNFIG
      CHARACTER CNFIG*48
C
C 3   Set dimension of run array to MAXRUN.
      PARAMETER (NRUND=500)
      COMMON/RUNS/RUN(NRUND)
C
C 4   Set dimensions of data-for-GROUND arrays here. WARNING: the
C     corresponding arrays in the MAIN program of EARTH (see
C     GROUND) must have the same dimensions.
      PARAMETER (NLGD=1000,NIGD=1000,NRGD=10000,NCGD=1000)
      COMMON/LGRND/LG(NLGD)/IGRND/IG(NIGD)/RGRND/RG(NRGD)
      COMMON/CGRND/CG(NCGD)
      LOGICAL LG
      CHARACTER*4 CG
C
C 5   Set dimensions of data-for-GREX1 arrays here. WARNING: the
C     corresponding arrays in the MAIN program of EARTH (see
C     GROUND) must have the same dimensions.
      COMMON/LSG/LSGD(20)/ISG/ISGD(20)/RSG/RSGD(100)/CSG/CSGD(10)
      LOGICAL LSGD
      CHARACTER*4 CSGD
C
C 6   Set dimensions for user-declared PIL variables here.
      PARAMETER (NIPD=1000,NRPD=1000)
      COMMON/NIDEC/INDEC(NIPD)/IDEC/INVAL(NIPD)
      COMMON/NRDEC/REDEC(NRPD)/RDEC/REVAL(NRPD)
      CHARACTER REDEC*6,INDEC*6
C
C 7   For more than the default of 80 variables increase nvd.
C     WARNING: the corresponding parameter nvd in the MAIN program of
```

```
C     EARTH (see ground.f) must be the same.
      PARAMETER (NVD=80)
      COMMON/LDB1/DBGPHI(NVD)/IDA1/ITERMS(NVD)/IDA2/LITER(NVD)
     1/IDA3/IORCVF(NVD)/IDA4/IORCVL(NVD)/IDA5/ISLN(NVD)/IDA6/IPRN(NVD)
     1/HDA1/NAME(NVD)/RDA1/DTFALS(NVD)/RDA2/RESREF(NVD)
     1/RDA3/PRNDTL(NVD)/RDA4/PRT(NVD)/RDA5/ENDIT(NVD)/RDA6/VARMIN(NVD)
     1/RDA7/VARMAX(NVD)/RDA8/FIINIT(NVD)/RDA9/PHINT(NVD)
     1/RDA10/CINT(NVD)/RDA11/EX(NVD)
     1/IPIP1/IP1(NVD)/HPIP2/IHP2(NVD)/RPIP1/RVAL(NVD)
     1/LPIP1/LVAL(NVD)
C
C 8   Set dimension indicators to correspond with above dimensions.
      CALL SUB4(MAXTCV,NTCVD,MAXRUN,NRUND,NBFC,NBFCD,NUMPHI,NVD)
      CALL SUB4(NLG,NLGD,NIG,NIGD,NRG,NRGD,NCG,NCGD)
      CALL SUB4(NLSG,20,NISG,20,NRSG,100,NCSG,10)
      CALL SUB4(NIPIL,NIPD,NRPIL,NRPD,NPNAM,NPATD,NSTACK,NLD)
      CALL SUB4(NXFR,NXFD,NYFR,NYFD,NZFR,NZFD,NTFR,NTFD)
C
C 9   Logical unit numbers & file names.
      CALL CNFGZZ(1)
      CALL OPENFL(6)
      CALL OPENFL(5)
      CALL READQ1(TALK,RUN,MAXRUN)
C
      CALL SMAIN1(TALK,MAXTCV,MAXRUN,NBFC,NUMPHI,NLG,NIG,NRG,NCG,
     1NLSG,NISG,NRSG,NCSG,NIPIL,NRPIL,NPNAM,NSTACK,NXFR,NYFR,NZFR,
     1NTFR)
      CALL WAYOUT(0)
      END
C************************************************************
      SUBROUTINE SAT
C
#include "satear"
#include "satloc"
C---- Call satellite used in BFC test-battery.
      CALL BFCTST
C---- the users USERST subroutine.
           IF(NAMSAT.EQ.'USER') CALL USERST
C---- Call the SATLIT subroutine.
      CALL SATLIT
      RETURN
      END
C************************************************************
      SUBROUTINE BFCTST
C
#include "satear"
#include "satloc"
      PARAMETER (NLGD=1000,NIGD=1000,NRGD=10000,NCGD=1000)
      COMMON/LGRND/LG(NLGD)/IGRND/IG(NIGD)/RGRND/RG(NRGD)
      COMMON/CGRND/CG(NCGD)
      LOGICAL LG
C
C---- Special sequence for BFC test battery : IG(1)=28
C
          IF(.NOT.(BFC.AND.IG(1).EQ.28.AND.IGR.EQ.1)) RETURN
      L1=MIN0(IG(2),NZ)
          IF(L1.LT.1) GO TO 2
        DO 1 IZ=1,L1
    1 CALL XCYIZ(IZ,LG(10))
    2 L2=MAX0(1,IG(3))
```

```
          IF(L2.GT.NZ) RETURN
        DO 3 IZ=L2,NZ
 3    CALL XCYIZ(IZ,LG(10))
      RETURN
      END
      SUBROUTINE USERST
      CALL WRIT40('DUMMY SUBROUTINE USERST CALLED.         ')
      RETURN
      END
C************************************************************
      SUBROUTINE SATLIT
C
#include "satear"
#include "satloc"
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX USER SECTION STARTS:
C
C 1   Set dimensions of blank-COMMON arrays here to the
C     dimensions of the same arrays in the MAIN program of the
C     satellite.
      PARAMETER (NXFD=1000,NYFD=1000,NZFD=1000,NTFD=10000)
      PARAMETER (NTCVD=25000,NBFCD=500000)
      COMMON TCVDA(NTCVD),XFRAC(NXFD),YFRAC(NYFD),ZFRAC(NZFD),
     1TFRAC(NTFD),BFCS(NBFCD)
C
C 2   Set dimensions of data-for-GROUND arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the
C     satellite program and the EARTH program must have the same
C     dimensions.
      PARAMETER (NLGD=1000,NIGD=1000,NRGD=10000,NCGD=1000)
      COMMON/LGRND/LG(NLGD)/IGRND/IG(NIGD)/RGRND/RG(NRGD)
      COMMON/CGRND/CG(NCGD)
      LOGICAL LG
      CHARACTER*4 CG
C
C 3   Introduce SATLIT-only commons, arrays, equivalences.
C
      DIMENSION SC(4),IX(16),XL(16),XP(16),IY(16),YL(16),YP(16),
     &          NZC(26),ZL(26),ZP(26),IZT(26),IZF1(26),IZF2(26),
     &          XAS(2500),YAS(2500),ZAS(2500),XAS1(2500),YAS1(2500),
     &          ZAS1(2500),XAS2(2500),YAS2(2500),ZAS2(2500),ZASL(100)
C
C 4   User places his data statements here.
C
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,
     122,23,24),IGR
C
C--- GROUP 1. Run title and other preliminaries
    1 CONTINUE
      WRITE(6,*)'                       IN SATLIT '
      RETURN
C
C--- GROUP 2. Transience; time-step specification
    2 CONTINUE
      RETURN
C
C--- GROUP 3. X-direction grid specification
    3 CONTINUE
      RETURN
C
C--- GROUP 4. Y-direction grid specification
```

```
    4 CONTINUE
      RETURN
C
C--- GROUP 5. Z-direction grid specification
    5 CONTINUE
C
      IF(IG(1).GT.2) RETURN
      IF(IG(1).EQ.0) WRITE(6,*)' CREATING GRID INPUT FILES'
      IF(IG(1).GE.1) WRITE(6,*)' CALCULATING INLET LOCATION'
C
C*********************************************************************
C-pd---First grid input file located at some distance between the-----
C---    inlet and the dynamometer.  There are no arcs in this---------
C---    section.------------------------------------------------------
C
      NI=14
      IX(1)=1
      CALL SETIV(IX,IG,100,1,NI)
C
      XCENA=RG(41)
      YCENA=RG(42)
      RAD1=RG(50)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(117)
      JFST=IG(137)
      ILST=IFST+1
      JLST=JFST+1
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,100,1,NI)
      XL(IFST   )=XCENA-DXI
      XL(IFST+1)=XCENA+DXI
C
      CALL SETRV(XP,RG,120,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,120,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,140,1,NI)
      YL(JFST   )=YCENA-DXI
      YL(JFST+1)=YCENA+DXI
C
      CALL SETRV(YP,RG,160,2,NI)
C
      LU=62
      CG(LU)='CS62'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(42)
      IRY=IG(43)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
      CALL WRTFI(LU,IRX,IRY,IX,IY)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(IRY+1)
C
C
C*********************************************************************
C-pd---Second grid input file located at a dynamometer cross----------
C---    section.  This input file contains the arcs for the------------
C---    inlet.  Unifrom grid spacing across the arc is assumed.--------
```

```
C
      LU=63
      CG(LU)='CS63'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data------------------------------
C
      ANG1= 45.0
      ANG2=135.0
      ANG3=225.0
      ANG4=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(ILST),IY(JFST),IY(JFST),
     &              XCENA,YCENA,RAD1,ANG3,ANG4,XP(IFST)
      WRITE(LU,104)IX(IFST),IX(ILST),IY(JLST),IY(JLST),
     &              XCENA,YCENA,RAD1,ANG2,ANG1,XP(IFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JLST),
     &              XCENA,YCENA,RAD1,ANG3,ANG2,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JLST),
     &              XCENA,YCENA,RAD1,ANG4,ANG1,YP(JFST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside---------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=0
      WRITE(LU,105)IX(IFST)+ISOL,IX(IFST+1)-ISOL,IY(JFST),IY(JFST+1)
      WRITE(LU,105)IX(IFST),IX(IFST+1),IY(JFST)+ISOL,IY(JFST+1)-ISOL
C
C
C***********************************************************************
C-pd---Third grid input file located at a inlet of calculation--------
C---   domain.  This input file uses the data from the first input----
C---   file and overwrites one of the vertical lines in order to------
C---   correspond to the inlet opening.-------------------------------
C
      DELO=50000.
      DO 510 I=1,IRX+1
      DEL=ABS(XL(I)-RG(65))
      IF (DEL.LT.DELO) THEN
        IPT=I
        DELO=DEL
      ENDIF
  510 CONTINUE
      XL(IPT)=RG(65)
C
C-pd---Send back to ql for boundary condition-------------------------
      IG(61)=IX(IPT)-1
      IF(IG(1).EQ.2) RETURN
C
      LU=61
      CG(LU)='CS61'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
      CALL WRTFI(LU,IRX,IRY,IX,IY)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(IRY+1)
C
C
C***********************************************************************
C-pd---Fourth grid input file located at a inlet of engine.-----------
C
      IX(1 )=1
      CALL SETIV(IX,IG,140,1,NI)
C
      XCENB=RG(43)
      YCENB=RG(44)
      RAD1=RG(51)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(157)
      JFST=IG(177)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,180,1,NI)
      XL(IFST  )=XCENB-DXI
      XL(IFST+2)=XCENB+DXI
C
      CALL SETRV(XP,RG,200,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,160,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,220,1,NI)
      YL(JFST  )=YCENB-DXI
      YL(JFST+2)=YCENB+DXI
C
      CALL SETRV(YP,RG,240,2,NI)
C
      LU=64
      CG(LU)='CS64'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(44)
      IRY=IG(45)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data------------------------------
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &               XCENB,YCENB,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &               XCENB,YCENB,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &               XCENB,YCENB,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &               XCENB,YCENB,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &               XCENB,YCENB,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &               XCENB,YCENB,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &               XCENB,YCENB,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &               XCENB,YCENB,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines--------------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &               XL(IMID),YL(JBEF),XL(IMID),YCENB-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &               XL(IMID),YCENB-RAD1,XL(IMID),YCENB,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &               XL(IMID),YCENB,XL(IMID),YCENB+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &               XL(IMID),YCENB+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &               XL(IBEF),YL(JMID),XCENB-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &               XCENB-RAD1,YL(JMID),XCENB,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &               XCENB,YL(JMID),XCENB+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &               XCENB+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside--------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=2
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
C
C**********************************************************************
C-pd---Fifth grid input file located at a exit of engine.  There------
C---   are two options for this location.  This one is for a gap of---
C---   approximately 3 or more inches between the exit of the --------
C---   engine and the augmenter tube.  The other option is for a------
```

```
C---   circle inside a circle.  Note:  This case uses the same--------
C---   spacing as for the engine inlet.-------------------------------
C
      IF(LG(2)) GOTO 560
C
      RAD1=RG(52)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(157)
      JFST=IG(177)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(IFST  )=XCENB-DXI
      XL(IFST+2)=XCENB+DXI
C
      YL(JFST  )=YCENB-DXI
      YL(JFST+2)=YCENB+DXI
C
      LU=65
      CG(LU)='CS65'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data------------------------------
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &              XCENB,YCENB,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &              XCENB,YCENB,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &              XCENB,YCENB,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &              XCENB,YCENB,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines-----------------------------------------------
C
```

```
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &              XL(IMID),YL(JBEF),XL(IMID),YCENB-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &              XL(IMID),YCENB-RAD1,XL(IMID),YCENB,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &              XL(IMID),YCENB,XL(IMID),YCENB+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &              XL(IMID),YCENB+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &              XL(IBEF),YL(JMID),XCENB-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &              XCENB-RAD1,YL(JMID),XCENB,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &              XCENB,YL(JMID),XCENB+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &              XCENB+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside--------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=2
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
C
C*************************************************************************
C-pd---This is the second option for exit of the engine.  There will--
C---   will be either 2 or 3 cross sections written here depending----
C---   on the location exit.  It will be 2 if it ends before the------
C---   augmenter tube or if it ends at the start of the tappered------
C---   section or at the start of straight section.  It will be 3-----
C---   if it falls in the tappered section or after the start of------
C---   the straight section.-----------------------------------------
C
  560 CONTINUE
      DO 561 I=1,IG(60)
C
      IX(1 )=1
      CALL SETIV(IX,IG,180,1,NI)
C
      XCENB=RG(43)
      YCENB=RG(44)
      XCENC=RG(45)
      YCENC=RG(46)
      RAD1=RG(53+I)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      RAD2=RG(56+I)/2.
      DXII=(RAD2*RAD2/2.)**0.5
      IFST=IG(197)
      JFST=IG(217)
C
C-pd---Do trig-------------------------------------------------------
C
```

```
      DXI02=DXI+(YCENB-YCENC)
      TETT02=ASIN(DXI02/RAD2)*180./3.141592654
      DXI16=DXI-(YCENB-YCENC)
      TETT16=ASIN(DXI16/RAD2)*180./3.141592654
      DXI04=DXI+(XCENB-XCENC)
      TETT04=ASIN(DXI04/RAD2)*180./3.141592654
      DXI06=DXI-(XCENB-XCENC)
      TETT06=ASIN(DXI06/RAD2)*180./3.141592654
      DXI08=DXI+(YCENB-YCENC)
      TETT08=ASIN(DXI08/RAD2)*180./3.141592654
      DXI10=DXI-(YCENB-YCENC)
      TETT10=ASIN(DXI10/RAD2)*180./3.141592654
      DXI12=DXI-(XCENB-XCENC)
      TETT12=ASIN(DXI12/RAD2)*180./3.141592654
      DXI14=DXI+(XCENB-XCENC)
      TETT14=ASIN(DXI14/RAD2)*180./3.141592654
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,260,1,NI)
      XL(IFST+1)=XCENB-DXI
      XL(IFST+3)=XCENB+DXI
      XL(IFST  )=XCENC-DXII
      XL(IFST+4)=XCENC+DXII
C
      CALL SETRV(XP,RG,280,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,200,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,300,1,NI)
      YL(JFST+1)=YCENB-DXI
      YL(JFST+3)=YCENB+DXI
      YL(JFST  )=YCENC-DXII
      YL(JFST+4)=YCENC+DXII
C
      CALL SETRV(YP,RG,320,2,NI)
C
      LU=64+I
      CG(LU)='CS  '
      I10=LU/10
      I1=LU-I10*10
      WRITE(CG(LU)(3:3),'(I1)') I10
      WRITE(CG(LU)(4:4),'(I1)') I1
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(46)
      IRY=IG(47)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data--------------------------------
C-pd---Inner circle-----------------------------------------------------
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      IFST=IG(197)+1
      JFST=IG(217)+1
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &              XCENB,YCENB,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &              XCENB,YCENB,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &              XCENB,YCENB,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &              XCENB,YCENB,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &              XCENB,YCENB,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines---------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &              XCENB,YCENB-RAD1,XCENB,YCENB,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &              XCENB,YCENB,XCENB,YCENB+RAD1,YP(JMID)
      WRITE(LU,1C2)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &              XCENB-RAD1,YCENB,XCENB,YCENB,XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &              XCENB,YCENB,XCENB+RAD1,YCENB,XP(IMID)
C
C-pd---Outer circle----------------------------------------------
C
      ANG01=  0.0
      ANG02=  0.0+TETT02
      ANG03= 45.0
      ANG04= 90.0-TETT04
      ANG05= 90.0
      ANG06= 90.0+TETT06
      ANG07=135.0
      ANG08=180.0-TETT08
      ANG09=180.0
      ANG10=180.0+TETT10
      ANG11=225.0
      ANG12=270.0-TETT12
      ANG13=270.0
      ANG14=270.0+TETT14
      ANG15=315.0
      ANG16=360.0-TETT16
      IFST=IG(197)
      JFST=IG(217)
      IMID=IFST+2
      JMID=JFST+2
      ILST=IFST+4
      JLST=JFST+4
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+5
      JAFT=JFST+5
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IFST+1),IY(JFST),IY(JFST),
     &                XCENC,YCENC,RAD2,ANG11,ANG12,XP(IFST)
      WRITE(LU,104)IX(IFST+1),IX(IMID),IY(JFST),IY(JFST),
     &                XCENC,YCENC,RAD2,ANG12,ANG13,XP(IFST+1)
      WRITE(LU,104)IX(IMID),IX(ILST-1),IY(JFST),IY(JFST),
     &                XCENC,YCENC,RAD2,ANG13,ANG14,XP(IMID)
      WRITE(LU,104)IX(ILST-1),IX(ILST),IY(JFST),IY(JFST),
     &                XCENC,YCENC,RAD2,ANG14,ANG15,XP(ILST-1)
      WRITE(LU,104)IX(IFST),IX(IFST+1),IY(JLST),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG07,ANG06,XP(IFST)
      WRITE(LU,104)IX(IFST+1),IX(IMID),IY(JLST),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG06,ANG05,XP(IFST+1)
      WRITE(LU,104)IX(IMID),IX(ILST-1),IY(JLST),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG05,ANG04,XP(IMID)
      WRITE(LU,104)IX(ILST-1),IX(ILST),IY(JLST),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG04,ANG03,XP(ILST-1)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JFST+1),
     &                XCENC,YCENC,RAD2,ANG11,ANG10,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST+1),IY(JMID),
     &                XCENC,YCENC,RAD2,ANG10,ANG09,YP(JFST+1)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST-1),
     &                XCENC,YCENC,RAD2,ANG09,ANG08,YP(JMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JLST-1),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG08,ANG07,YP(JLST-1)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JFST+1),
     &                XCENC,YCENC,RAD2,ANG15,ANG16,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST+1),IY(JMID),
     &                XCENC,YCENC,RAD2,ANG16,ANG01,YP(JFST+1)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST-1),
     &                XCENC,YCENC,RAD2,ANG01,ANG02,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JLST-1),IY(JLST),
     &                XCENC,YCENC,RAD2,ANG02,ANG03,YP(JLST-1)
C
C-pd---Shuffle lines-----------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &                XL(IMID),YL(JBEF),XCENC,YCENC-RAD2,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JFST+1),
     &                XCENC,YCENC-RAD2,XCENB,YCENB-RAD1,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST-1),IY(JLST),
     &                XCENB,YCENB+RAD1,XCENC,YCENC+RAD2,YP(JLST-1)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &                XCENC,YCENC+RAD2,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &                XL(IBEF),YL(JMID),XCENC-RAD2,YCENC,XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IFST+1),IY(JMID),IY(JMID),
     &                XCENC-RAD2,YCENC,XCENB-RAD1,YCENB,XP(IFST)
      WRITE(LU,102)IX(ILST-1),IX(ILST),IY(JMID),IY(JMID),
     &                XCENB+RAD1,YCENB,XCENC+RAD2,YCENC,XP(ILST-1)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &                XCENC+RAD2,YCENC,XL(IAFT),YL(JMID),XP(ILST)
```

```
C
C-pd---More trig-----------------------------------------------------
C
      DELL02=(RAD2*RAD2-DXI02*DXI02)**0.5
      DELL04=(RAD2*RAD2-DXI04*DXI04)**0.5
      DELL06=(RAD2*RAD2-DXI06*DXI06)**0.5
      DELL08=(RAD2*RAD2-DXI08*DXI08)**0.5
      DELL10=(RAD2*RAD2-DXI10*DXI10)**0.5
      DELL12=(RAD2*RAD2-DXI12*DXI12)**0.5
      DELL14=(RAD2*RAD2-DXI14*DXI14)**0.5
      DELL16=(RAD2*RAD2-DXI16*DXI16)**0.5
C
      WRITE(LU,*)
      WRITE(LU,102)IX(IFST+1),IX(IFST+1),IY(JBEF),IY(JFST),
     &          XL(IFST+1),YL(JBEF),XL(IFST+1),YCENC-DELL12,YP(JBEF)
      WRITE(LU,102)IX(IFST+1),IX(IFST+1),IY(JFST),IY(JFST+1),
     &          XL(IFST+1),YCENC-DELL12,XL(IFST+1),YL(JFST+1),YP(JFST)
      WRITE(LU,102)IX(IFST+1),IX(IFST+1),IY(JLST-1),IY(JLST),
     &          XL(IFST+1),YL(JLST-1),XL(IFST+1),YCENC+DELL06,YP(JLST-1)
      WRITE(LU,102)IX(IFST+1),IX(IFST+1),IY(JLST),IY(JAFT),
     &          XL(IFST+1),YCENC+DELL06,XL(IFST+1),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(ILST-1),IX(ILST-1),IY(JBEF),IY(JFST),
     &          XL(ILST-1),YL(JBEF),XL(ILST-1),YCENC-DELL14,YP(JBEF)
      WRITE(LU,102)IX(ILST-1),IX(ILST-1),IY(JFST),IY(JFST+1),
     &          XL(ILST-1),YCENC-DELL14,XL(ILST-1),YL(JFST+1),YP(JFST)
      WRITE(LU,102)IX(ILST-1),IX(ILST-1),IY(JLST-1),IY(JLST),
     &          XL(ILST-1),YL(JLST-1),XL(ILST-1),YCENC+DELL04,YP(JLST-1)
      WRITE(LU,102)IX(ILST-1),IX(ILST-1),IY(JLST),IY(JAFT),
     &          XL(ILST-1),YCENC+DELL04,XL(ILST-1),YL(JAFT),YP(JLST)
C
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JFST+1),IY(JFST+1),
     &          XL(IBEF),YL(JFST+1),XCENC-DELL10,YL(JFST+1),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IFST+1),IY(JFST+1),IY(JFST+1),
     &          XCENC-DELL10,YL(JFST+1),XL(IFST+1),YL(JFST+1),XP(IFST)
      WRITE(LU,102)IX(ILST-1),IX(ILST),IY(JFST+1),IY(JFST+1),
     &          XL(ILST-1),YL(JFST+1),XCENC+DELL16,YL(JFST+1),XP(ILST-1)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JFST+1),IY(JFST+1),
     &          XCENC+DELL16,YL(JFST+1),XL(IAFT),YL(JFST+1),XP(ILST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JLST-1),IY(JLST-1),
     &          XL(IBEF),YL(JLST-1),XCENC-DELL08,YL(JLST-1),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IFST+1),IY(JLST-1),IY(JLST-1),
     &          XCENC-DELL08,YL(JLST-1),XL(IFST+1),YL(JLST-1),XP(IFST)
      WRITE(LU,102)IX(ILST-1),IX(ILST),IY(JLST-1),IY(JLST-1),
     &          XL(ILST-1),YL(JLST-1),XCENC+DELL02,YL(JLST-1),XP(ILST-1)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JLST-1),IY(JLST-1),
     &          XCENC+DELL02,YL(JLST-1),XL(IAFT),YL(JLST-1),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside---------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=2
      WRITE(LU,105)IX(IFST+1)+ISOL,IX(ILST-1)-ISOL,IY(JFST+1),IY(JLST-1)
      WRITE(LU,105)IX(IFST+1),IX(ILST-1),IY(JFST+1)+ISOL,IY(JLST-1)-ISOL
```

```
C
      WRITE(LU,105)IX(IFST+1),IX(ILST-1),IY(JFST),IY(JFST+1)
      WRITE(LU,105)IX(IFST),IX(IFST+1),IY(JFST+1),IY(JLST-1)
      WRITE(LU,105)IX(ILST-1),IX(ILST),IY(JFST+1),IY(JLST-1)
      WRITE(LU,105)IX(IFST+1),IX(ILST-1),IY(JLST-1),IY(JLST)
C
  561 CONTINUE
C
C
C**********************************************************************
C-pd---This is the second option for the lip of the augmenter tube.---
C---   This section is used if enough gap between the exit of the-----
C---   engine exists.-------------------------------------------------
C
      IF(LG(2)) GOTO 580
C
      IX(1 )=1
      CALL SETIV(IX,IG,220,1,NI)
C
      XCENC=RG(45)
      YCENC=RG(46)
      RAD1=RG(53)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(237)
      JFST=IG(257)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,340,1,NI)
      XL(IFST  )=XCENC-DXI
      XL(IFST+2)=XCENC+DXI
C
      CALL SETRV(XP,RG,360,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,240,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,380,1,NI)
      YL(JFST  )=YCENC-DXI
      YL(JFST+2)=YCENC+DXI
C
      CALL SETRV(YP,RG,400,2,NI)
C
      LU=66
      CG(LU)='CS66'
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(48)
      IRY=IG(49)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data-----------------------------
```

```
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines-----------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &              XL(IMID),YL(JBEF),XL(IMID),YCENC-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &              XL(IMID),YCENC-RAD1,XL(IMID),YCENC,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &              XL(IMID),YCENC,XL(IMID),YCENC+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &              XL(IMID),YCENC+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &              XL(IBEF),YL(JMID),XCENC-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &              XCENC-RAD1,YL(JMID),XCENC,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &              XCENC,YL(JMID),XCENC+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &              XCENC+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside--------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=4
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
```

```
C
C*******************************************************************
C-pd---This section is for the constant cross sectional area of the---
C---   augmenter sleeve.--------------------------------------------
C
  580 CONTINUE
C
      IX(1 )=1
      CALL SETIV(IX,IG,220,1,NI)
C
      XCENC=RG(45)
      YCENC=RG(46)
      RAD1=RG(60)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(237)
      JFST=IG(257)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,340,1,NI)
      XL(IFST  )=XCENC-DXI
      XL(IFST+2)=XCENC+DXI
C
      CALL SETRV(XP,RG,360,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,240,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,380,1,NI)
      YL(JFST  )=YCENC-DXI
      YL(JFST+2)=YCENC+DXI
C
      CALL SETRV(YP,RG,400,2,NI)
C
      IF(LG(2)) THEN
        LU=65+IG(60)
      ELSE
        LU=67
      ENDIF
      CG(LU)='CS  '
      I10=LU/10
      I1=LU-I10*10
      WRITE(CG(LU)(3:3),'(I1)') I10
      WRITE(CG(LU)(4:4),'(I1)') I1
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(48)
      IRY=IG(49)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data----------------------------
C
```

```
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines--------------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &              XL(IMID),YL(JBEF),XL(IMID),YCENC-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &              XL(IMID),YCENC-RAD1,XL(IMID),YCENC,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &              XL(IMID),YCENC,XL(IMID),YCENC+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &              XL(IMID),YCENC+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &              XL(IBEF),YL(JMID),XCENC-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &              XCENC-RAD1,YL(JMID),XCENC,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &              XCENC,YL(JMID),XCENC+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &              XCENC+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside---------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=4
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
C
```

```
C************************************************************************
C-pd---This section is for the constant cross sectional area of the---
C---   augmenter tube.---------------------------------------------------
C
      IX(1 )=1
      CALL SETIV(IX,IG,220,1,NI)
C
      XCENC=RG(45)
      YCENC=RG(46)
      RAD1=RG(61)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IFST=IG(237)
      JFST=IG(257)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,340,1,NI)
      XL(IFST   )=XCENC-DXI
      XL(IFST+2)=XCENC+DXI
C
      CALL SETRV(XP,RG,360,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,240,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,380,1,NI)
      YL(JFST   )=YCENC-DXI
      YL(JFST+2)=YCENC+DXI
C
      CALL SETRV(YP,RG,400,2,NI)
C
      IF(LG(2)) THEN
        LU=66+IG(60)
      ELSE
        LU=68
      ENDIF
      CG(LU)='CS   '
      I10=LU/10
      I1=LU-I10*10
      WRITE(CG(LU)(3:3),'(I1)') I10
      WRITE(CG(LU)(4:4),'(I1)') I1
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(48)
      IRY=IG(49)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C
C-pd---Overwrite line info with arc data------------------------------
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &              XCENC,YCENC,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &              XCENC,YCENC,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &              XCENC,YCENC,RAD1,ANG1,ANG2,YP(JMID)
C
C-pd---Shuffle lines-----------------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &              XL(IMID),YL(JBEF),XL(IMID),YCENC-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &              XL(IMID),YCENC-RAD1,XL(IMID),YCENC,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &              XL(IMID),YCENC,XL(IMID),YCENC+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &              XL(IMID),YCENC+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &              XL(IBEF),YL(JMID),XCENC-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &              XCENC-RAD1,YL(JMID),XCENC,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &              XCENC,YL(JMID),XCENC+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &              XCENC+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
      CALL WRTFI(LU,IRX,IRY,IX,IY)
C
C-pd---Fix points around circle and certain ones inside--------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=4
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
C
C**********************************************************************
C-pd---This section is for the constant cross sectional area of the---
C---   augmenter tube.  This cross section is located at the back-----
```

```
C---   side of the end wall.  Two options exist, one for a circle-----
C---   and one for a square.-------------------------------------------
C
      IX(1 )=1
      CALL SETIV(IX,IG,260,1,NI)
C
      XCEND=RG(47)
      YCEND=RG(48)
      RAD1=RG(62)/2.
      DXI=(RAD1*RAD1/2.)**0.5
      IF(LG(3)) DXI=RAD1
      IFST=IG(277)
      JFST=IG(297)
      IMID=IFST+1
      JMID=JFST+1
      ILST=IFST+2
      JLST=JFST+2
      IBEF=IFST-1
      JBEF=JFST-1
      IAFT=IFST+3
      JAFT=JFST+3
C
      XL(1 )=0.0
      CALL SETRV(XL,RG,420,1,NI)
      XL(IFST  )=XCEND-DXI
      XL(IFST+2)=XCEND+DXI
C
      CALL SETRV(XP,RG,440,2,NI)
C
      IY(1 )=1
      CALL SETIV(IY,IG,280,1,NI)
C
      YL(1 )=0.0
      CALL SETRV(YL,RG,460,1,NI)
      YL(JFST  )=YCEND-DXI
      YL(JFST+2)=YCEND+DXI
C
      CALL SETRV(YP,RG,480,2,NI)
C
      IF(LG(2)) THEN
        LU=67+IG(60)
      ELSE
        LU=69
      ENDIF
      CG(LU)='CS  '
      I10=LU/10
      I1=LU-I10*10
      WRITE(CG(LU)(3:3),'(I1)') I10
      WRITE(CG(LU)(4:4),'(I1)') I1
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IF(RG(LU+10).NE.0.0) XL(1)=RG(LU+10)
      IRX=IG(50)
      IRY=IG(51)
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
      IF(LG(3)) GOTO 590
C
C-pd---Overwrite line info with arc data------------------------------
C
      ANG1=  0.0
      ANG2= 45.0
      ANG3= 90.0
      ANG4=135.0
      ANG5=180.0
      ANG6=225.0
      ANG7=270.0
      ANG8=315.0
      WRITE(LU,*)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JFST),IY(JFST),
     &             XCEND,YCEND,RAD1,ANG6,ANG7,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JFST),IY(JFST),
     &             XCEND,YCEND,RAD1,ANG7,ANG8,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IMID),IY(JLST),IY(JLST),
     &             XCEND,YCEND,RAD1,ANG4,ANG3,XP(IFST)
      WRITE(LU,104)IX(IMID),IX(ILST),IY(JLST),IY(JLST),
     &             XCEND,YCEND,RAD1,ANG3,ANG2,XP(IMID)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JFST),IY(JMID),
     &             XCEND,YCEND,RAD1,ANG6,ANG5,YP(JFST)
      WRITE(LU,104)IX(IFST),IX(IFST),IY(JMID),IY(JLST),
     &             XCEND,YCEND,RAD1,ANG5,ANG4,YP(JMID)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JFST),IY(JMID),
     &             XCEND,YCEND,RAD1,ANG8,ANG1,YP(JFST)
      WRITE(LU,104)IX(ILST),IX(ILST),IY(JMID),IY(JLST),
     &             XCEND,YCEND,RAD1,ANG1,ANG2,YP(JMID)
C
C
C-pd---Shuffle lines------------------------------------------------
C
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JBEF),IY(JFST),
     &             XL(IMID),YL(JBEF),XL(IMID),YCEND-RAD1,YP(JBEF)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JFST),IY(JMID),
     &             XL(IMID),YCEND-RAD1,XL(IMID),YCEND,YP(JFST)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JMID),IY(JLST),
     &             XL(IMID),YCEND,XL(IMID),YCEND+RAD1,YP(JMID)
      WRITE(LU,102)IX(IMID),IX(IMID),IY(JLST),IY(JAFT),
     &             XL(IMID),YCEND+RAD1,XL(IMID),YL(JAFT),YP(JLST)
      WRITE(LU,102)IX(IBEF),IX(IFST),IY(JMID),IY(JMID),
     &             XL(IBEF),YL(JMID),XCEND-RAD1,YL(JMID),XP(IBEF)
      WRITE(LU,102)IX(IFST),IX(IMID),IY(JMID),IY(JMID),
     &             XCEND-RAD1,YL(JMID),XCEND,YL(JMID),XP(IFST)
      WRITE(LU,102)IX(IMID),IX(ILST),IY(JMID),IY(JMID),
     &             XCEND,YL(JMID),XCEND+RAD1,YL(JMID),XP(IMID)
      WRITE(LU,102)IX(ILST),IX(IAFT),IY(JMID),IY(JMID),
     &             XCEND+RAD1,YL(JMID),XL(IAFT),YL(JMID),XP(ILST)
C
  590 CALL WRTFI(LU,IRX,IRY,IX,IY)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(IRY+1)
      IF(LG(3)) GOTO 591
C
C-pd---Fix points around circle and certain ones inside--------------
C
      WRITE(LU,*)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(JFST)
      WRITE(LU,105)IX(1),IX(IFST),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(ILST),IX(IRX+1),IY(JFST),IY(JLST)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(JLST),IY(IRY+1)
C
      ISOL=4
      WRITE(LU,105)IX(IFST)+ISOL,IX(ILST)-ISOL,IY(JFST),IY(JLST)
      WRITE(LU,105)IX(IFST),IX(ILST),IY(JFST)+ISOL,IY(JLST)-ISOL
C
```

```
  591 CONTINUE
      J1TMP=IY(JFST)
      J2TMP=IY(JLST)
      YDTMP=YL(IRY+1)
C
C
C***********************************************************************
C-pd---This section is for the exit of the chimney.  Unifrom spacing--
C---   in each direction is assummed.---------------------------------
      IX(1)=1
      IX(2)=NX+1
C
      XL(1)=XL(1)
      XL(2)=XL(IRX+1)
C
      XP(1)=1.0
C
      IY(1)=1
      IY(2)=NY+1
C
      YL(1)=RG(510+IG(537))
      YL(2)=RG(510+IG(537)-1)
C
      YP(1)=1.0
C
      IF(LG(2)) THEN
        LU=68+IG(60)
      ELSE
        LU=70
      ENDIF
      CG(LU)='CS  '
      I10=LU/10
      I1=LU-I10*10
      WRITE(CG(LU)(3:3),'(I1)') I10
      WRITE(CG(LU)(4:4),'(I1)') I1
      OPEN(LU,FILE=CG(LU),FORM='FORMATTED',STATUS='UNKNOWN')
      IRX=1
      IRY=1
      CALL WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
      CALL WRTFI(LU,IRX,IRY,IX,IY)
      WRITE(LU,105)IX(1),IX(IRX+1),IY(1),IY(IRY+1)
C
      IF(IG(1).EQ.0) THEN
        WRITE(6,*)' TOTAL NUMBER OF GRID INPUT FILES CREATED = ',LU-60
        WRITE(6,*)' AT THIS POINT USE GGP TO CREATE GRID PLANES'
        RETURN
      ENDIF
C
C
C***********************************************************************
C***********************************************************************
C-pd---Call ggp-------------------------------------------------------
C
C         INACTIVE
C
C
C
C***********************************************************************
C***********************************************************************
C
```

```
      WRITE(6,*)' CREATING READCO FILE'
C
C-pd---Stack grids (NOTE:  SFAC hardwired in - SATLIT call before-----
C---   conversions set in Q1)--------------------------------------------
C
      SFAC=0.0254
      NI=25
      LMX=(NX+1)*(NY+1)
      CALL SETIV(NZC,IG,510,3,NI)
      ZL(1 )=0.0
      CALL SETRV(ZL,RG,510,1,NI)
      CALL SETRV(ZP,RG,540,2,NI)
      CALL SETIV(IZT,IG,540,3,NI)
      CALL SETIV(IZF1,IG,570,3,NI)
      CALL SETIV(IZF2,IG,600,3,NI)
C
      LUW1=88
      OPEN(LUW1,FILE='grid',FORM='FORMATTED',STATUS='UNKNOWN')
      WRITE(LUW1,366)NX+1,NY+1,NZ+1
C
      DO 5005 I=1,IG(501)
      IF(IZT(I).EQ.1) THEN
        CALL XSTACK(CG(IZF1(I)),LMX,NZC(I),ZL(I),ZL(I+1),ZP(I),
     &              XAS1,YAS1,ZASL,SFAC,LUW1)
      ELSEIF (IZT(I).EQ.2) THEN
        CALL XBLEND(CG(IZF1(I)),CG(IZF2(I)),LMX,NZC(I),ZL(I),ZL(I+1),
     &              ZP(I),XAS,YAS,XAS1,YAS1,XAS2,YAS2,ZASL,SFAC,LUW1)
      ELSEIF (IZT(I).EQ.3) THEN
        CALL XCURVE(CG(IZF1(I)),LMX,NZC(I),ZL(I),ZL(I+1),ZP(I),YDTMP,
     &              J1TMP,J2TMP,YAS,ZAS,XAS1,YAS1,SFAC,LUW1)
      ELSEIF (IZT(I).EQ.4) THEN
        CALL XLASTS(CG(IZF2(I)),LMX,NZC(I),YDTMP,RG(537),ZP(I),
     &              XAS,ZAS,XAS1,ZAS1,XAS2,ZAS2,ZL,SFAC,LUW1)
      ELSE
        WRITE(6,*)' ERROR IN STACKING TYPE '
      ENDIF
 5005 CONTINUE
      CLOSE(LUW1,STATUS='KEEP')
C
      RETURN
C
  102 FORMAT('LI',4I3,F12.6,3F11.6,F7.2)
  104 FORMAT('AR',4I3,F12.6,4F11.6,F7.2)
  105 FORMAT('FXY'4I3)
  366 FORMAT(3I5)
C
C--- GROUP 6. Body-fitted coordinates or grid distortion
    6 CONTINUE
      RETURN
C
C--- GROUP 7. Variables stored, solved & named
    7 CONTINUE
      RETURN
C
C--- GROUP 8. Terms (in differential equations) & devices
    8 CONTINUE
      RETURN
C
C--- GROUP 9. Properties of the medium (or media)
    9 CONTINUE
```

```
C
      IF(IG(1).NE.3) RETURN
      WRITE(6,*)' CALCULATING BOUNDARY CONDITIONS'
C
C-pd---Ambient----------------------------------------------------------
      RGAS=RG(25)
      SC(1)=RG(1)/RG(21)
      SC(2)=RG(2)/RG(22)
      SC(3)=RG(3)/RG(23)
      SC(4)=RG(4)/RG(24)
      TEMP=RG(13)
      CALL ENTHAL(TEMP,HSUM,CPSUM,SC,4,0)
      RG(16)=CPSUM*RGAS*TEMP
C-pd---Dynometer--------------------------------------------------------
      SC(1)=RG(5)/RG(21)
      SC(2)=RG(6)/RG(22)
      SC(3)=RG(7)/RG(23)
      SC(4)=RG(8)/RG(24)
      TEMP=RG(14)
      CALL ENTHAL(TEMP,HSUM,CPSUM,SC,4,0)
      RG(17)=CPSUM*RGAS*TEMP
C-pd---Engine-----------------------------------------------------------
      SC(1)=RG(9)/RG(21)
      SC(2)=RG(10)/RG(22)
      SC(3)=RG(11)/RG(23)
      SC(4)=RG(12)/RG(24)
      TEMP=RG(15)
      CALL ENTHAL(TEMP,HSUM,CPSUM,SC,4,0)
      RG(18)=CPSUM*RGAS*TEMP
      RETURN
C
C--- GROUP 10. Inter-phase-transfer processes and properties
   10 CONTINUE
      RETURN
C
C--- GROUP 11. Initialization of variable or porosity fields
   11 CONTINUE
      RETURN
C
C--- GROUP 12. Convection and diffusion adjustments
   12 CONTINUE
      RETURN
C
C--- GROUP 13. Boundary conditions and special sources
   13 CONTINUE
      RETURN
C
C--- GROUP 14. Downstream pressure for PARAB=.TRUE.
   14 CONTINUE
      RETURN
C
C--- GROUP 15. Termination of sweeps
   15 CONTINUE
      RETURN
C
C--- GROUP 16. Termination of iterations
   16 CONTINUE
      RETURN
C
C--- GROUP 17. Under-relaxation devices
```

```
   17 CONTINUE
      RETURN
C
C--- GROUP 18. Limits on variables or increments to them
   18 CONTINUE
      RETURN
C
C--- GROUP 19. Data communicated by satellite to GROUND
   19 CONTINUE
      RETURN
C
C--- GROUP 20. Preliminary print-out
   20 CONTINUE
      RETURN
C
C--- GROUP 21. Print-out of variables
   21 CONTINUE
      RETURN
C
C--- GROUP 22. Spot-value print-out
   22 CONTINUE
      RETURN
C
C--- GROUP 23. Field print-out and plot control
   23 CONTINUE
      RETURN
C
C--- GROUP 24. Dumps for restarts
   24 CONTINUE
      WRITE(6,*)'                                 OUT OF IT '
      RETURN
      END
C***********************************************************************
      SUBROUTINE GCALE(GFACT)
C***********************************************************************
C  GCALE gets information needed to scale grid points.
C---------------------------------------------------------------------
C
      INCLUDE 'satear'
      INCLUDE 'satloc'
      INCLUDE 'bfcsat'
      COMMON F(1)
C
      NI=NX+1
      NJ=NY+1
      NK=NZ+1
      JNNN=NI*NJ*NK
      CALL SCALEW(F(KXC+1),F(KYC+1),F(KZC+1),GFACT,JNNN)
C
      RETURN
      END
C
C***********************************************************************
      SUBROUTINE SCALEW(X,Y,Z,F,N)
C***********************************************************************
C  GCALEW converts grid nodes to the proper units (m).
C---------------------------------------------------------------------
C
      DIMENSION X(*),Y(*),Z(*)
C
```

```
      DO 1 I=1,N
      X(I)=X(I)*F
      Y(I)=Y(I)*F
    1 Z(I)=Z(I)*F
C
      RETURN
      END
C
C************************************************************************
      SUBROUTINE ENTHAL(TEMP,HSUM,CPSUM,SC,NS,NFO)
C************************************************************************
C  ENTHAL calculates H/RT from JANNAF data.  The order of
C  species is N O C H.
C----------------------------------------------------------------------
C
      DIMENSION SC(4),ZS(7,2,4)
      DATA ZS/ 0.28532899E+01,  0.16022128E-02, -0.62936893E-06,
     &         0.11441022E-09, -0.78057465E-14, -0.89008093E+03,
     &         0.63964897E+01,  0.37044177E+01, -0.14218753E-02,
     &         0.28670392E-05, -0.12028885E-08, -0.13954677E-13,
     &        -0.10640795E+04,  0.22336285E+01,
     &         0.36122139E+01,  0.74853166E-03, -0.19820647E-06,
     &         0.33749008E-10, -0.23907374E-14, -0.11978151E+04,
     &         0.36703307E+01,  0.37837135E+01, -0.30233634E-02,
     &         0.99492751E-05, -0.98189101E-08,  0.33031825E-11,
     &        -0.10638107E+04,  0.36416345E+01,
     &         0.44608041E+01,  0.30981719E-02, -0.12392571E-05,
     &         0.22741325E-09, -0.15525954E-13, -0.48961442E+05,
     &        -0.98635982E+00,  0.24007797E+01,  0.87350957E-02,
     &        -0.66070878E-05,  0.20021861E-08,  0.63274039E-15,
     &        -0.48377527E+05,  0.96951457E+01,
     &         0.27167633E+01,  0.29451374E-02, -0.80224374E-06,
     &         0.10226682E-09, -0.48472145E-14, -0.29905826E 05,
     &         0.66305671E+01,  0.40701275E+01, -0.11084499E-02,
     &         0.41521180E-05, -0.29637404E-08,  0.80702103E-12,
     &        -0.30279722E+05, -0.32270046E+00 /
C
      K=1
      IF(TEMP.LT.1000.) K=2
      TEMP2=TEMP*TEMP
      HSUM=0.
      CPSUM=0.
      DO 100 IS=1,NS
      CP1=ZS(1,K,IS)
      CP2=ZS(2,K,IS)*TEMP
      CP3=ZS(3,K,IS)*TEMP2
      CP4=ZS(4,K,IS)*TEMP2*TEMP
      CP5=ZS(5,K,IS)*TEMP2*TEMP2
      CPSUM=CPSUM+SC(IS)*(CP1+CP2+CP3+CP4+CP5)
  100 HSUM =HSUM+
     1  SC(IS)*(CP1+.5*CP2+.33333*CP3+.25*CP4+.2*CP5+ZS(6,K,IS)/TEMP)
C
      RETURN
      END
C
C************************************************************************
      SUBROUTINE SETIV(IA,IG,IFST,ITY,NI)
C************************************************************************
C  SETIV places interger values from the IG arrary into the
C  proper local array.
```

```
C---------------------------------------------------------------------
C
      DIMENSION IA(*),IG(*)
C
      IF(ITY.EQ.1) THEN
        DO 1 I=1,NI
    1   IA(I+1)=IG(IFST+I)+1
      ELSEIF (ITY.EQ.2) THEN
        DO 2 I=1,NI
    2   IA(I)=IG(IFST+I)+1
      ELSEIF (ITY.EQ.3) THEN
        DO 3 I=1,NI
    3   IA(I)=IG(IFST+I)
      ELSE
        WRITE(6,*)' ERROR SETIV --- INVALID TYPE '
      ENDIF
C
      RETURN
      END
C
C***********************************************************************
      SUBROUTINE SETRV(RA,RG,IFST,ITY,NI)
C***********************************************************************
C  SETRV places real values from the RG arrary into the proper
C  local array.
C---------------------------------------------------------------------
C
      DIMENSION RA(*),RG(*)
C
      IF(ITY.EQ.1) THEN
        DO 1 I=1,NI
    1   RA(I+1)=RG(IFST+I)
      ELSEIF (ITY.EQ.2) THEN
        DO 2 I=1,NI
    2   RA(I)=RG(IFST+I)
      ELSE
        WRITE(6,*)' ERROR SETRV --- INVALID TYPE '
      ENDIF
C
      RETURN
      END
C
C***********************************************************************
      SUBROUTINE WRTSQ(LU,NX,NY,IRX,IRY,IX,IY,XL,YL,XP,YP)
C***********************************************************************
C  WRTSQ writes input grid file assuming all straight lines.
C---------------------------------------------------------------------
C
      DIMENSION IX(*),IY(*),XL(*),YL(*),XP(*),YP(*)
C
      WRITE(LU,100) NX+1
      WRITE(LU,101) NY+1
      DO 10 I=1,IRY+1
      WRITE(LU,*)
      DO 10 J=1,IRX
   10 WRITE(LU,102)
     &     IX(J),IX(J+1),IY(I),IY(I),XL(J),YL(I),XL(J+1),YL(I),XP(J)
      DO 20 I=1,IRX+1
      WRITE(LU,*)
      DO 20 J=1,IRY
   20 WRITE(LU,102)
     &     IX(I),IX(I),IY(J),IY(J+1),XL(I),YL(J),XL(I),YL(J+1),YP(J)
C
  100 FORMAT('IMAX',I3)
  101 FORMAT('JMAX',I3)
  102 FORMAT('LI',4I3,F12.6,3F11.6,F7.2)
C
      RETURN
      END
C
C************************************************************************
      SUBROUTINE WRTFI(LU,IRX,IRY,IX,IY)
C************************************************************************
C  WRTFI writes commands needed to fill subsections.
C-----------------------------------------------------------------------
C
      DIMENSION IX(*),IY(*)
C
      DO 10 I=1,IRY
      WRITE(LU,*)
      DO 10 J=1,IRX
   10 WRITE(LU,103)IX(J),IX(J+1),IY(I),IY(I+1)
C
  103 FORMAT('FI',4I3)
C
      RETURN
      END
C
C************************************************************************
      SUBROUTINE XSTACK(F1PRE,LMX,NZC,ZFST,ZLST,ZP,X1,Y1,ZL,CV,LUW1)
C************************************************************************
C  XSTACK repeats one computational grid file
C-----------------------------------------------------------------------
C
      CHARACTER*4 F1PRE,FEXT
      CHARACTER*8 F1NAME
      DIMENSION X1(*),Y1(*),ZL(*)
C
      FEXT='.GRD'
      F1NAME=F1PRE//FEXT
      LUR1=80
      OPEN(LUR1,FILE=F1NAME,FORM='FORMATTED',STATUS='OLD')
C
      READ(LUR1,366)LP1,MP1,NTP1
      READ(LUR1,333)((X1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((Y1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((ZTEMP, IJ=I,LMX,LP1),I=1,LP1)
C
      CALL ZLSET(ZL,1,NZC+1,ZFST,ZLST,ZP)
C
      DO 10 K=1,NZC
      WRITE(LUW1,333)((X1(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Y1(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((ZL(K)*CV, IJ=I,LMX,LP1),I=1,LP1)
   10 CONTINUE
      CLOSE(LUR1,STATUS='KEEP')
C
      RETURN
  333 FORMAT(5(1P,E13.6))
  366 FORMAT(3I5)
```

```
      END
C
C***********************************************************************
      SUBROUTINE XBLEND(F1PRE,F2PRE,LMX,NZC,ZFST,ZLST,ZP,X,Y,X1,Y1,
     &                 X2,Y2,ZL,CV,LUW1)
C***********************************************************************
C  XBLEND blends two computational grids files
C-----------------------------------------------------------------------
C
      CHARACTER*4 F1PRE,F2PRE,FEXT
      CHARACTER*8 F1NAME,F2NAME
      DIMENSION X(2500),Y(2500),X1(2500),Y1(2500),X2(2500),Y2(2500),
     &          ZL(100)
C
      FEXT='.GRD'
      F1NAME=F1PRE//FEXT
      F2NAME=F2PRE//FEXT
      LUR1=80
      LUR2=81
      OPEN(LUR1,FILE=F1NAME,FORM='FORMATTED',STATUS='OLD')
      OPEN(LUR2,FILE=F2NAME,FORM='FORMATTED',STATUS='OLD')
C
      READ(LUR1,366)LP1,MP1,NTP1
      READ(LUR1,333)((X1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((Y1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((ZTEMP, IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR2,366)LP1,MP1,NTP1
      READ(LUR2,333)((X2(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR2,333)((Y2(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR2,333)((ZTEMP, IJ=I,LMX,LP1),I=1,LP1)
C
      CALL ZLSET(ZL,1,NZC+1,ZFST,ZLST,ZP)
C
      DO 20 K=1,NZC
      DO 21 I=1,LMX
      IF(NZC.EQ.1) THEN
        X(I)=X1(I)
        Y(I)=Y1(I)
      ELSE
        X(I)=X1(I)*FLOAT(NZC-K+1)/FLOAT(NZC)+
     &         X2(I)*FLOAT(K-1)/FLOAT(NZC)
        Y(I)=Y1(I)*FLOAT(NZC-K+1)/FLOAT(NZC)+
     &         Y2(I)*FLOAT(K-1)/FLOAT(NZC)
      ENDIF
   21 CONTINUE
      WRITE(LUW1,333)((X(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Y(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((ZL(K)*CV,IJ=I,LMX,LP1),I=1,LP1)
   20 CONTINUE
      CLOSE(LUR1,STATUS='KEEP')
      CLOSE(LUR2,STATUS='KEEP')
C
      RETURN
  333 FORMAT(5(1P,E13.6))
  366 FORMAT(3I5)
      END
C
C***********************************************************************
      SUBROUTINE XCURVE(F1PRE,LMX,NZC,ZFST,ZLST,ZP,CENC,NY2,NY3,
     &                 Y,Z,X1,Y1,CV,LUW1)
```

```
C***********************************************************************
C  XCURVE creates the grid in the augmenter tube bend section
C---------------------------------------------------------------------
C
      CHARACTER*4 F1PRE,FEXT
      CHARACTER*8 F1NAME
      DIMENSION Y(*),Z(*),X1(*),Y1(*)
C
      FEXT='.GRD'
      F1NAME=F1PRE//FEXT
      LUR1=80
C
C-pd---NZC number of cells in bend  (WARNING: Must be even)-----------
C---   NY1 lower Y line-----------------------------------------------
C---   NY2 lower Y circle line----------------------------------------
C---   NY3 upper Y circle line----------------------------------------
C---   NY4 upper Y line-----------------------------------------------
C
      OPEN(LUR1,FILE=F1NAME,FORM='FORMATTED',STATUS='OLD')
      READ(LUR1,366)LP1,MP1,NTP1
      READ(LUR1,333)((X1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((Y1(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((ZTEMP ,IJ=I,LMX,LP1),I=1,LP1)
C
      NY1=1
      NY4=MP1
      ZLEN=ZLST-ZFST
C
C-pd---Do Boundary----------------------------------------------------
      WRITE(LUW1,333)((X1(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Y1(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((ZFST*CV,  IJ=I,LMX,LP1),I=1,LP1)
C
      DO 400 IP=1,NZC
      ANG=90.0/FLOAT(NZC)*FLOAT(IP)
      PI=3.141592654
      RAD=ANG/360.*2.*PI
      YFAC=COS(RAD)
C
C-pd---Lower Y row----------------------------------------------------
      DO 205 I=1,LP1
      IF(IP.LE.NZC/2) THEN
        Y(I)=0.0
      ELSE
        Y(I)=FLOAT(IP-(NZC/2))/FLOAT(NZC/2)*CENC
      ENDIF
  205 CONTINUE
C
C-pd---Lower Y circle row---------------------------------------------
      IAD=(NY2-1)*LP1
      DO 210 I=1,LP1
      Y(IAD+I)=Y1(IAD+I)+(1.0-YFAC)*(CENC-Y1(IAD+I))
  210 CONTINUE
C
C-pd---Upper Y circle row---------------------------------------------
      IAD=(NY3-1)*LP1
      DO 215 I=1,LP1
      Y(IAD+I)=Y1(IAD+I)+(1.0-YFAC)*(CENC-Y1(IAD+I))
  215 CONTINUE
C
```

```
C-pd---Upper Y row----------------------------------------------------
      IAD=(MP1-1)*LP1
      DO 220 I=1,LP1
C-pd---add fact to give a north cell area-----------------------------
      Y(IAD+I)=Y1(IAD+I)+((FLOAT(IP)/FLOAT(NZC))*0.01)
  220 CONTINUE
C
C-pd---Fill first section---------------------------------------------
      DO 250 J=2,NY2-1
      DO 250 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=0
      IAD2=(NY2-1)*LP1
      Y(LOC)=Y(IAD1+I)+((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Y(IAD2+I)-Y(IAD1+I)))
  250 CONTINUE
C
C-pd---Fill circle section--------------------------------------------
      DO 260 J=NY2+1,NY3-1
      DO 260 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=(NY2-1)*LP1
      IAD2=(NY3-1)*LP1
      Y(LOC)=Y(IAD1+I)+((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Y(IAD2+I)-Y(IAD1+I)))
  260 CONTINUE
C
C-pd---Fill top section-----------------------------------------------
      DO 270 J=NY3+1,MP1-1
      DO 270 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=(NY3-1)*LP1
      IAD2=(MP1-1)*LP1
      Y(LOC)=Y(IAD1+I)+((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Y(IAD2+I)-Y(IAD1+I)))
  270 CONTINUE
C
C
      ZD4=0.0
C
C-pd---Lower Z row----------------------------------------------------
      ZFAC=SIN(RAD)
      DO 305 I=1,LP1
      IF(IP.LE.NZC/2) THEN
        Z(I)=FLOAT(IP)/FLOAT(NZC/2)*ZLEN+ZFST
      ELSE
        Z(I)=ZLEN+ZFST
      ENDIF
  305 CONTINUE
C
C-pd---Lower Z circle row---------------------------------------------
      IAD=(NY2-1)*LP1
      DO 310 I=1,LP1
      Z(IAD+I)=SIN(RAD)*(CENC-Y1(IAD+I))+ZFST
  310 CONTINUE
C
C-pd---Upper Z circle row---------------------------------------------
      IAD=(NY3-1)*LP1
      DO 315 I=1,LP1
      Z(IAD+I)=SIN(RAD)*(CENC-Y1(IAD+I))+ZFST
  315 CONTINUE
C
C-pd---Upper Z row-----------------------------------------------------
      IAD=(MP1-1)*LP1
      DO 320 I=1,LP1
      Z(IAD+I)=ZD4+ZFST
  320 CONTINUE
C
C-pd---Fill first section----------------------------------------------
      DO 350 J=2,NY2-1
      DO 350 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=0
      IAD2=(NY2-1)*LP1
      Z(LOC)=Z(IAD1+I)-((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Z(IAD1+I)-Z(IAD2+I)))
  350 CONTINUE
C
C-pd---Fill circle section---------------------------------------------
      DO 360 J=NY2+1,NY3-1
      DO 360 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=(NY2-1)*LP1
      IAD2=(NY3-1)*LP1
      Z(LOC)=Z(IAD1+I)-((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Z(IAD1+I)-Z(IAD2+I)))
  360 CONTINUE
C
C-pd---Fill top section------------------------------------------------
      DO 370 J=NY3+1,MP1-1
      DO 370 I=1,LP1
      LOC=(J-1)*LP1+I
      IAD1=(NY3-1)*LP1
      IAD2=(MP1-1)*LP1
      Z(LOC)=Z(IAD1+I)-((Y1(LOC)-Y1(IAD1+I))/
     +        (Y1(IAD2+I)-Y1(IAD1+I))*(Z(IAD1+I)-Z(IAD2+I)))
  370 CONTINUE
C
C-pd---Write data------------------------------------------------------
      WRITE(LUW1,333)((X1(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Y(IJ)*CV, IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Z(IJ)*CV, IJ=I,LMX,LP1),I=1,LP1)
  400 CONTINUE
C
      CLOSE(LUR1,STATUS='KEEP')
C
      RETURN
C
  333 FORMAT(5(1P,E13.6))
  366 FORMAT(3I5)
C
      END
C
C***********************************************************************
      SUBROUTINE XLASTS(F1PRE,LMX,NZC,YFST,YLST,ZP,
     &              X,Z1,X1,Z,X2,Z2,YL,CV,LUW1)
C***********************************************************************
C  XLASTS creates the grid in the last section
C----------------------------------------------------------------------
C
```

```
      CHARACTER*4 F1PRE,F2PRE,FEXT
      CHARACTER*8 F1NAME
      DIMENSION X(*),Z(*),X1(*),Z1(*),X2(*),Z2(*),YL(*)
C
      FEXT='.GRD'
      F1NAME=F1PRE//FEXT
      LUR1=80
C
C-pd---Do last section (blend)----------------------------------------
      OPEN(LUR1,FILE=F1NAME,FORM='FORMATTED',STATUS='OLD')
      READ(LUR1,366)LP1,MP1,NTP1
      READ(LUR1,333)((X2(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((Z2(IJ),IJ=I,LMX,LP1),I=1,LP1)
      READ(LUR1,333)((ZTEMP ,IJ=I,LMX,LP1),I=1,LP1)
      K1=1
      KL=NZC+1
      CALL ZLSET(YL,K1,KL,YFST,YLST,ZP)
      DO 440 K=2,NZC+1
      DO 441 I=1,LMX
      IF(NZC.EQ.1) THEN
        X(I)=X1(I)
        Z(I)=Z1(I)
      ELSE
        X(I)=X1(I)*FLOAT(NZC-K+1)/FLOAT(NZC)+
     &         X2(I)*FLOAT(K-1)/FLOAT(NZC)
        Z(I)=Z1(I)*FLOAT(NZC-K+1)/FLOAT(NZC)+
     &         Z2(I)*FLOAT(K-1)/FLOAT(NZC)
      ENDIF
  441 CONTINUE
      WRITE(LUW1,333)((X(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((YL(K)*CV,IJ=I,LMX,LP1),I=1,LP1)
      WRITE(LUW1,333)((Z(IJ)*CV,IJ=I,LMX,LP1),I=1,LP1)
  440 CONTINUE
      CLOSE(LUR1,STATUS='KEEP')
C
      RETURN
  333 FORMAT(5(1P,E13.6))
  366 FORMAT(3I5)
      END
C
C*********************************************************************
      SUBROUTINE ZLSET(ZBND,INDEX1,INDEXL,Z1,ZL,PWR)
C*********************************************************************
C
C (C) COPYRIGHT 1991 DOC D of North America, Inc.  ALL RIGHTS RESERVED
C
C  Read input parameters to distribute a number of points along a
C  line segment.
C  Syntax is : LINE  K1  KL  Z1  ZL  [PWR]
C--------------------------------------------------------------------
      DIMENSION ZBND(*)
C
      IF(PWR.GT.0) THEN
        K1=INDEX1
        KL=INDEXL
        INC=1
        DELZ = ZL-Z1
        ZF = Z1
      ELSE
        K1=INDEXL
```

```
          KL=INDEX1
          INC=-1
          DELZ = Z1-ZL
          ZF = ZL
          PWR=ABS(PWR)
        ENDIF
        DO 10 I = K1,KL,INC
        RAT = (FLOAT(I-K1)/FLOAT(KL-K1))**PWR
        ZBND(I) = ZF + DELZ*RAT
     10 CONTINUE
C
        RETURN
        END
```

APPENDIX D

```
C FILE NAME GROUND.FTN--------------------------------22 April 87
C THIS IS THE MAIN PROGRAM OF EARTH
C
C   (C) COPYRIGHT 1984, LAST REVISION 1987.
C   CONCENTRATION HEAT AND MOMENTUM LTD. ALL RIGHTS RESERVED.
C   This subroutine and the remainder of the PHOENICS code are
C   proprietary software owned by Concentration Heat and Momentum
C   Limited, 40 High Street, Wimbledon, London SW19 5AU, England.
C
C
C     PROGRAM MAIN
C
C 1   The following two COMMON's, which appear identically in the
C     satellite MAIN program, allow up to 80 dependent variables to
C     be solved for (or their storage spaces to be occupied by
C     other variables, such as density). If a larger number is
C     required increase the parameter nvd. Less than 50 for nvd is not
C     permitted.
C
C     If more patches are required increase npatd.
C
C     If a larger F-array is needed increase nfd.
C
      PARAMETER (NVD=80,NFD=18000000,NPATD=1000)
C
      COMMON/LGE4/L4(NVD)
     1/LDB1/L5(NVD)/IDA1/I1(NVD)/IDA2/I2(NVD)/IDA3/I3(NVD)/IDA4/I4(NVD)
     1/IDA5/I5(NVD)/IDA6/I6(NVD)/GI1/I7(NVD)/GI2/I8(NVD)/HDA1/IH1(NVD)
     1/GH1/IH2(NVD)/RDA1/R1(NVD)/RDA2/R2(NVD)/RDA3/R3(NVD)/RDA4/R4(NVD)
     1/RDA5/R5(NVD)/RDA6/R6(NVD)/RDA7/R7(NVD)/RDA8/R8(NVD)/RDA9/R9(NVD)
     1/RDA10/R10(NVD)/RDA11/R11(NVD)
     1/GR1/R12(NVD)/GR2/R13(NVD)/GR3/R14(NVD)/GR4/R15(NVD)
     1/IPIP1/IP1(NVD)/HPIP2/IHP2(NVD)/RPIP1/RVAL(NVD)/LPIP1/LVAL(NVD)
     1/IFPL/IPL0(NVD)/RFPL1/ORPRIN(NVD)/RFPL2/ORMAX(NVD)
     1/RFPL3/ORMIN(NVD)
      LOGICAL L1,L2,L3,L4,L5,DBGFIL,LVAL
      CHARACTER*4 IH1,IH2,IHP2,NSDA
C
      COMMON/F01/I9(4*NVD)
      COMMON/DISC/DBGFIL
      COMMON/LUNITS/LUNIT(60)
      EXTERNAL WAYOUT
C
C 2   Set dimensions of data-for-GROUND arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the satellite
C     (see SATLIT) must have the same dimensions.
      COMMON/LGRND/LG(1000)/IGRND/IG(1000)/RGRND/RG(10000)
      COMMON/CGRND/CG(1000)
      LOGICAL LG
      CHARACTER*4 CG
C
C 3   Set dimensions of data-for-GREX2 arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the satellite
C     (see SATLIT) must have the same dimensions.
      COMMON/LSG/LSGD(20)/ISG/ISGD(20)/RSG/RSGD(100)/CSG/CSGD(10)
      LOGICAL LSGD
      CHARACTER*4 CSGD
C
C 4   Set dimension of patch-name array here. WARNING: the array
C     NAMPAT in the MAIN program of the satellite must have the
```

```
C     dimension.
      COMMON/NPAT/NAMPAT(NPATD)
      CHARACTER*8 NAMPAT
C
C     CONFIG FILE name declaration.
      COMMON/CNFG/CNFIG
      CHARACTER CNFIG*48
C
C 5   The numbers in the next two statements (which must be ident-
C     ical) indicate how much computer memory is to be set aside
C     for storing the main and auxiliary variables. The user may
C     alter them if he wishes, to accord with the number of
C     grid nodes and dependent variables he is concerned with.
      COMMON F(NFD)
      NFDIM=NFD
C
C 6   Logical-unit numbers and file names, not to be changed.
      CALL CNFGZZ(2)
      CALL EARSET(1)
      CALL OPENFL(6)
C
C     User may here change message transmitted to logical unit
C     LUPR3
      CALL WRIT40('Ground-Station is ground.f, 09/25/87.   ')
      CALL MAIN1(NFDIM)
      CALL WAYOUT(0)
      STOP
      END
C**************************************************************
      SUBROUTINE GROSTA
C
#include "satear"
#include "grdloc"
#include "grdear"
C.... This subroutine directs control to the GROUNDs selected by
C     the satellite settings of USEGRX, NAMGRD & USEGRD.
C
C          Subroutine GREX2 contains options for fluid properties,
C     turbulence models, wall functions, chemical reaction etc. It
C     was introduced in version 1.4 of PHOENICS.
C
          IF(USEGRX) CALL GREX2
C
C.... BTSTGR contains the sequences used in conjunction with
C     the BFC test battery.
C
          IF(NAMGRD.EQ.'BTST') CALL BTSTGR
C
C.... TESTGR contains test battery sequences used in conjunction
C     with the test-battery SATLIT subroutine, TESTST.
C
          IF(NAMGRD.EQ.'TEST') CALL TESTGR
C
C.... SPECGR is a generic "special" GROUND the name of which can
C     be used by anyone for their own purposes. SPC1GR, SPC2GR and
C     SPC3GR permit the user to attach his own library of special
C     GROUNDs selected according to the prescription of NAMGRD.
C
          IF(NAMGRD.EQ.'SPEC') CALL SPECGR
C
```

```
C.... The subroutine GROUND attached to the bottom of this file is
C     an unallocated blank form into which the user can insert his
C     own FORTRAN sequences. The PIL parameter USEGRD governs entry
C     in to it.
C
          IF(USEGRD) CALL GROUND
C
C.... The data echo is called at the preliminary print-out stage.
          IF(IGR.NE.20) RETURN
          IF(.NOT.ECHO) GO TO 20
      CALL DATPRN(Y,Y,Y,Y,  Y,Y,Y,Y,  Y,Y,Y,N,  Y,Y,Y,Y,
     &            Y,Y,Y,Y,  Y,Y,Y,Y)
      RETURN
   20 CALL DATPRN(Y,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N)
      RETURN
      END
      SUBROUTINE SPECGR
      CALL WRIT40('DUMMY SUBROUTINE SPECGR CALLED.         ')
      CALL WRIT40('PLEASE ATTACH SPECGR OBJECT AT LINK.    ')
      CALL WAYOUT(2)
      RETURN
      END
      SUBROUTINE QUIZ
      RETURN
      END
C***************************************************************
      SUBROUTINE GROUND
C
#include "satear"
#include "grdloc"
#include "grdear"
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX USER SECTION STARTS:
C
C 1   Set dimensions of data-for-GROUND arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the satellite
C     and EARTH must have the same dimensions.
      COMMON/LGRND/LG(1000)/IGRND/IG(1000)/RGRND/RG(10000)
      COMMON/CGRND/CG(1000)
      COMMON/GR3/RESD(1)
      LOGICAL LG,DONE
      CHARACTER*4 CG,ADIR*1,ANUX*1
      DATA DONE /.FALSE./
      INTEGER TEMP,CP,PH2O,TFAR,RHOE,SPAR
C
C 2   User dimensions own arrays here, for example:
C     DIMENSION UUH(10,10),UUC(10,10),UUX(10,10),UUZ(10)
      PARAMETER (JNX=45,JNY=40,JNXY=JNX*JNY)
      DIMENSION GAH(JNY,JNX),GP1(JNY,JNX),GH1(JNY,JNX),GC1(JNY,JNX),
     &          GC2(JNY,JNX),GC3(JNY,JNX),GRH(JNY,JNX),GTMP(JNY,JNX),
     &          GVPR(JNY,JNX),GCP(JNY,JNX),PHI(JNY,JNX),A1(JNXY),
     &          A2(JNXY),A3(JNXY),A4(JNXY),A5(JNXY),A6(JNXY)
      DIMENSION SC(4)
C
C 3   User places his data statements here, for example:
C     DATA NXDIM,NYDIM/10,10/
      EQUIVALENCE (TEMP,C4),(CP,C5),(PH2O,C8),(TFAR,C9),(RHOE,C10),
     &            (SPAR,C11)
C
C 4   Insert own coding below as desired, guided by GREX2 examples.
C     Note that the satellite-to-GREX2 special data in the labelled
```

```
C     COMMONs /RSG/, /ISG/, /LSG/ and /CSG/ (which are now automatically
C     included in grdloc) can be used but the user must check GREX2 for any
C     conflicting uses. The same comment applies to the EARTH-spare working
C     arrays EASP1, EASP2,....EASP10. If the call to GREX2 has been
C     deactivated then they can all be used without reservation.
C
      IXL=IABS(IXL)
          IF(IGR.EQ.13) GO TO 13
          IF(IGR.EQ.19) GO TO 19
      GO TO (1,2,3,4,5,6,24,8,9,10,11,12,13,14,24,24,24,24,19,20,24,
     124,23,24),IGR
C*****************************************************************
C
C--- GROUP 1. Run title and other preliminaries
C
    1 GO TO (1001,1002),ISC
 1001 CONTINUE
C
      NSC=4
      NFO=0
      TNY=1.E-15
      RGAS=RG(25)
      JSWPRN=TSTSWP
      PTRAP=RG(29)
C
      RETURN
 1002 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 2. Transience; time-step specification
C
    2 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 3. X-direction grid specification
C
    3 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 4. Y-direction grid specification
C
    4 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 5. Z-direction grid specification
C
    5 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 6. Body-fitted coordinates or grid distortion
C
    6 CONTINUE
      RETURN
C*****************************************************************
C   * Make changes for this group only in group 19.
```

```
C--- GROUP 7. Variables stored, solved & named
C****************************************************************
C
C--- GROUP 8. Terms (in differential equations) & devices
C
    8 GO TO (81,82,83,84,85,86,87,88,89,810,811,812,813,814,815)
     1,ISC
   81 CONTINUE
C   * ------------------ SECTION  1 --------------------------
C    For U1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   82 CONTINUE
C   * ------------------ SECTION  2 --------------------------
C    For U2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
   83 CONTINUE
C   * ------------------ SECTION  3 --------------------------
C    For V1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   84 CONTINUE
C   * ------------------ SECTION  4 --------------------------
C    For V2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
   85 CONTINUE
C   * ------------------ SECTION  5 --------------------------
C    For W1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   86 CONTINUE
C   * ------------------ SECTION  6 --------------------------
C    For W2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
   87 CONTINUE
C   * ------------------ SECTION 7 ---- VOLUMETRIC SOURCE FOR GALA
      RETURN
   88 CONTINUE
C   * ------------------ SECTION 8 --- CONVECTION FLUXES
      RETURN
   89 CONTINUE
C   * ------------------ SECTION 9 --- DIFFUSION COEFFICIENTS
      RETURN
  810 CONTINUE
C   * ------------------ SECTION 10 --- CONVECTION NEIGHBOURS
      RETURN
  811 CONTINUE
C   * ------------------ SECTION 11 --- DIFFUSION NEIGHBOURS
      RETURN
  812 CONTINUE
C   * ------------------ SECTION 12 --- LINEARISED SOURCES
      RETURN
  813 CONTINUE
C   * ------------------ SECTION 13 --- CORRECTION COEFFICIENTS
      RETURN
  814 CONTINUE
C   * ------------------ SECTION 14 --- USER'S SOLVER
      RETURN
  815 CONTINUE
C   * ------------------ SECTION 15 --- CHANGE SOLUTION
      RETURN
C   * Make all other group-8 changes in group 19.
C****************************************************************
```

```
C
C--- GROUP 9. Properties of the medium (or media)
C
C    The sections in this group are arranged sequentially in their
C    order of calling from EARTH. Thus, as can be seen from below,
C    the temperature sections (10 and 11) precede the density
C    sections (1 and 3); so, density formulae can refer to
C    temperature stores already set.
    9 GO TO (91,92,93,94,95,96,97,98,99,900,901,902,903),ISC
C*****************************************************************
  900 CONTINUE
C   * ------------------- SECTION 10 ---------------------------
C     For TMP1.LE.GRND--------- phase-1 temperature Index AUX(TEMP1)
      RETURN
  901 CONTINUE
C   * ------------------- SECTION 11 ---------------------------
C     For TMP2.LE.GRND--------- phase-2 temperature Index AUX(TEMP2)
      RETURN
  902 CONTINUE
C   * ------------------- SECTION 12 ---------------------------
C     For EL1.LE.GRND--------- phase-1 length scale Index AUX(LEN1)
      RETURN
  903 CONTINUE
C   * ------------------- SECTION 13 ---------------------------
C     For EL2.LE.GRND--------- phase-2 length scale Index AUX(LEN2)
      RETURN
   91 CONTINUE
C   * ------------------- SECTION  1 ---------------------------
C     For RHO1.LE.GRND--- density for phase 1 Index AUX(DEN1).
C
      CALL GETYX (P1,GP1,JNY,JNX)
      CALL GETYX (H1,GH1,JNY,JNX)
      CALL GETYX (C1,GC1,JNY,JNX)
      CALL GETYX (TEMP,GTMP,JNY,JNX)
      CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
      DO 9101 IX=1,NX
      DO 9101 IY=1,NY
      IF (GVPR(IY,IX).LE.1.E-4) THEN
        GC3(IY,IX)=0.0
        GTMP(IY,IX)=300.
        PHI(IY,IX)=0.0
        GRH(IY,IX)=1.
        GOTO 9101
      ENDIF
C-pd---Calculate mass fractions----------------------------------------
      GC3(IY,IX)=1.0-GC1(IY,IX)
      SC(1)=(GC3(IY,IX)*RG(1)+GC1(IY,IX)*RG(9))/RG(21)
      SC(2)=(GC3(IY,IX)*RG(2)+GC1(IY,IX)*RG(10))/RG(22)
      SC(3)=(GC3(IY,IX)*RG(3)+GC1(IY,IX)*RG(11))/RG(23)
      SC(4)=(GC3(IY,IX)*RG(4)+GC1(IY,IX)*RG(12))/RG(24)
      SC(1)=AMAX1(1.E-10,SC(1))
      SC(2)=AMAX1(1.E-10,SC(2))
      SC(3)=AMAX1(1.E-10,SC(3))
      SC(4)=AMAX1(1.E-10,SC(4))
      TGUS=GTMP(IY,IX)
      HSTAT=GH1(IY,IX)
      CALL TEMPER(HSTAT,TGUS,TCELL,CPDR,RGAS,SC,NSC,NFO)
C
      TCELL=AMAX1(273.,TCELL)
      TCELL=AMIN1(950.,TCELL)
```

```
C
      GP=PRESS0+GP1(IY,IX)
      PHI(IY,IX)=1.0/(GP+TNY)
      XMWA=1.0/(SC(1)+SC(2)+SC(3)+SC(4))
      GRH(IY,IX)=GP*XMWA/(RGAS*TCELL+TNY)
      GTMP(IY,IX)=TCELL
      GCP(IY,IX)=CPDR*RGAS
 9101 CONTINUE
C
      CALL SETYX(AUX(DEN1),GRH,JNY,JNX)
      CALL SETYX(C3,GC3,JNY,JNX)
      CALL SETYX(TEMP,GTMP,JNY,JNX)
      CALL SETYX(CP,GCP,JNY,JNX)
C
      RETURN
   92 CONTINUE
C   * ------------------- SECTION  2 ---------------------------
C    For DRH1DP.LE.GRND--- D(LN(DEN))/DP for phase 1 (D1DP).
      CALL SETYX(D1DP,PHI,JNY,JNX)
      RETURN
   93 CONTINUE
C   * ------------------- SECTION  3 ---------------------------
C    For RHO2.LE.GRND--- density for phase 2 Index AUX(DEN2).
      RETURN
   94 CONTINUE
C   * ------------------- SECTION  4 ---------------------------
C    For DRH2DP.LE.GRND--- D(LN(DEN))/DP for phase 2 (D2DP).
      RETURN
   95 CONTINUE
C   * ------------------- SECTION  5 ---------------------------
C    For ENUT.LE.GRND--- reference turbulent kinematic viscosity.
      RETURN
   96 CONTINUE
C   * ------------------- SECTION  6 ---------------------------
C    For ENUL.LE.GRND--- reference laminar kinematic viscosity.
      RETURN
   97 CONTINUE
C   * ------------------- SECTION  7 ---------------------------
C    For PRNDTL( ).LE.GRND--- laminar PRANDTL nos., or diffusivity.
      RETURN
   98 CONTINUE
C   * ------------------- SECTION  8 ---------------------------
C    For PHINT( ).LE.GRND--- interface value of first phase(FII1).
      RETURN
   99 CONTINUE
C   * ------------------- SECTION  9 ---------------------------
C    For PHINT( ).LE.GRND--- interface value of second phase(FII2)
      RETURN
C*****************************************************************
C
C--- GROUP 10. Inter-phase-transfer processes and properties
C
   10 GO TO (101,102,103,104),ISC
  101 CONTINUE
C   * ------------------- SECTION  1 ---------------------------
C    For CFIPS.LE.GRND--- inter-phase friction coeff. AUX(INTFRC).
      RETURN
  102 CONTINUE
C   * ------------------- SECTION  2 ---------------------------
C    For CMDOT.EQ.GRND- inter-phase mass transfer Index AUX(INTMDT)
```

```
      RETURN
  103 CONTINUE
C   * ------------------- SECTION  3 ---------------------------
C    For CINT( ).EQ.GRND--- phase1-to-interface transfer
C                                            coefficients (COI1)
      RETURN
  104 CONTINUE
C   * ------------------- SECTION  4 ---------------------------
C    For CINT( ).EQ.GRND--- phase2-to-interface transfer
C                                            coefficients (COI2)
      RETURN
C*****************************************************************
C
C--- GROUP 11. Initialization of variable or porosity fields
C
   11 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 12. Convection and diffusion adjustments
C
   12 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 13. Boundary conditions and special sources
C
   13 CONTINUE
      GO TO (130,131,132,133,134,135,136,137,138,139,1310,
     11311,1312,1313,1314,1315,1316,1317,1318,1319,1320,1321),ISC
  130 CONTINUE
C------------------- SECTION  1 ------------- coefficient = GRND
      RETURN
  131 CONTINUE
C------------------- SECTION  2 ------------- coefficient = GRND1
      RETURN
  132 CONTINUE
C------------------- SECTION  3 ------------- coefficient = GRND2
      RETURN
  133 CONTINUE
C------------------- SECTION  4 ------------- coefficient = GRND3
      RETURN
  134 CONTINUE
C------------------- SECTION  5 ------------- coefficient = GRND4
      RETURN
  135 CONTINUE
C------------------- SECTION  6 ------------- coefficient = GRND5
      RETURN
  136 CONTINUE
C------------------- SECTION  7 ------------- coefficient = GRND6
      RETURN
  137 CONTINUE
C------------------- SECTION  8 ------------- coefficient = GRND7
      IF(INDVAR.GT.P1) GO TO 13799
      CALL GETYX(AUX(DEN1),A1,NY,NX)
      CALL GETYX(P1       ,A2,NY,NX)
      CALL GETCOV(NPATCH,INAME('UCRT'),COEFF,GKLOSS)
      CALL GETCOV(NPATCH, P1 ,COEFF,GPBV  )
      I=(IXF-2)*NY
      DO 13701 II=IXF,IXL
```

```
        I=I + NY
        DO 13702 J=IYF,IYL
          IJ=I + J
          DELTAP=AMAX1(ABS(A2(IJ)-GPBV),PTRAP)
          RHO   =A1(IJ)
          COEFF =SQRT(2.*RHO/(GKLOSS*DELTAP))
          A1(IJ)=COEFF
13702   CONTINUE
13701   CONTINUE
      CALL SETYX(CO,A1,NY,NX)
      RETURN
13799 CALL WRIT40('CO = GRND7 FOR VARIABLE BESIDES P1 !!!! ')
      CALL WAYOUT(1)
      RETURN
  138 CONTINUE
C------------------- SECTION  9 ------------- coefficient = GRND8
C
C ... GENERATE WALL SHEAR COEFFICIENTS ....
C
      CALL FNLGLW(CO,CO,AK,1.0001,EWAL,4)
C
C ... NOW CONVERT TO Stanton #'s ....
C
      CALL GETYX(CO,A1,NY,NX)
      RPRL=1./PRNDTL(H1)
      RPRT=1./PRT(H1)
      P   =9.*(RPRT/RPRL - 1.)*(RPRL/RPRT)**0.25
      I=(IXF-2)*NY
      DO 13801 II=IXF,IXL
        I=I + NY
        DO 13802 J=IYF,IYL
          IJ=I + J
          S=A1(IJ)
          STL=S*RPRL
          STT=S*RPRT/(1. + P*SQRT(S))
          A1(IJ)=AMAX1(STL,STT)
13802   CONTINUE
13801 CONTINUE
C
C ... NOW ASSEMBLE COMPOSITE HEAT TRANSFER COEFFICIENTS ....
C
      CALL GETYX(AUX(DEN1),A2,NY,NX)
      CALL GETYX(LD7      ,A3,NY,NX)
      CALL GETYX(CP       ,A4,NY,NX)
      CALL GETCOV(NPATCH,INAME('UCRT'),COND,THICK)
      CWALL=COND/(THICK+TINY)
C
      CALL SUB4(I1,IXF,I2,IXL,J1,IYF,J2,IYL)
      READ(NPATCH(8:8),'(A1)') ADIR
      NDIREC=0
      IF(ADIR.EQ.'E' .OR. ADIR.EQ.'e') NDIREC= 1
      IF(ADIR.EQ.'W' .OR. ADIR.EQ.'w') NDIREC=-1
      IF(ADIR.EQ.'N' .OR. ADIR.EQ.'n') NDIREC= 2
      IF(ADIR.EQ.'S' .OR. ADIR.EQ.'s') NDIREC=-2
      IDIR=IABS(NDIREC)
      IF(IDIR.EQ.1) THEN
        KAREA=5
        KADD=NY
        I2=I1
      ELSEIF(IDIR.EQ.2) THEN
```

```
        KAREA=7
        KADD=1
        J2=J1
      ELSE
        CALL WRIT40('PATCH NAME PROTOCOL VIOLATED FOR GRND8  ')
        CALL WRIT40('COEFFICIENT OF CONJUGATE HEAT TRANSFER  ')
        CALL WRIT40('MODEL. TSK TSK TSK                  `   ')
        CALL WAYOUT(1)
      ENDIF
C
      I=(I1-2)*NY
      DO 13811 II=I1,I2
        I=I + NY
        DO 13812 J=J1,J2
          IJ1=I + J
          IJ2=IJ1 + KADD
          ST1=A1(IJ1)
          ST2=A1(IJ2)
          RO1=A2(IJ1)
          RO2=A2(IJ2)
          VW1=A3(IJ1)
          VW2=A3(IJ2)
          CP1=A4(IJ1)
          CP2=A4(IJ2)
          CO1=RO1*VW1*CP1*ST1
          CO2=RO2*VW2*CP2*ST2
          COEFF=CO1*CWALL*CO2/(CO1*CWALL + CO1*CO2 + CWALL*CO2 + TINY)
          A5(IJ1)=COEFF/CP1
          A5(IJ2)=COEFF/CP2
          A6(IJ1)=COEFF
          A6(IJ2)=COEFF
13812   CONTINUE
13811 CONTINUE
C
      CALL SETYX(C6,A5,NY,NX)
      CALL SETYX(C7,A6,NY,NX)
C
C ... NOW MULTIPLY BY CORRECT AREA'S & DIVIDE BY PATGEO,RHO & Vwall ....
C
      CALL GTIZYX(KAREA,IZ,A1,NY,NX)
      I=(I1-2)*NY
      DO 13821 II=I1,I2
        I=I + NY
        DO 13822 J=J1,J2
          IJ1=I + J
          IJ2=IJ1 + KADD
          AREA=A1(IJ1)
          A5(IJ1)=A5(IJ1)*AREA
          A5(IJ2)=A5(IJ2)*AREA
13822   CONTINUE
13821 CONTINUE
C
      CALL GETYX(PATGEO,A1,NY,NX)
      I=(IXF-2)*NY
      DO 13831 II=IXF,IXL
        I=I + NY
        DO 13832 J=IYF,IYL
          IJ=I + J
          A5(IJ)=A5(IJ)/(A1(IJ)*A2(IJ)*A3(IJ) + TINY)
13832   CONTINUE
```

```
13831 CONTINUE
C
      CALL SETYX(CO,A5,NY,NX)
      CALL FN1(LGEN1,0.0)
C
C ... ADD UP TOTAL HEAT TRANSFERRED ....
C
      IF(ISWEEP.LT.LSWEEP-1.AND.MOD(ISWEEP,IG(901)).NE.0) RETURN
C
      CALL WRITBL
      CALL WRIT40('ADDING UP TOTAL Qdot FROM DUCT TO AIR.  ')
      CALL WRIT2I('SWEEP # ',ISWEEP,',SLAB # ',IZSTEP)
      CALL GETYX(H1,A4,NY,NX)
      CALL GETYX(CP,A2,NY,NX)
      CALL SUB4(I1,IXF,I2,IXL,J1,IYF,J2,IYL)
      IF    (NDIREC.EQ. 1) THEN
        I1=I2
        KADD=-NY
      ELSEIF(NDIREC.EQ.-1) THEN
        I2=I1
        KADD= NY
      ELSEIF(NDIREC.EQ. 2) THEN
        J1=J2
        KADD=-1
      ELSEIF(NDIREC.EQ.-2) THEN
        J2=J1
        KADD= 1
      ENDIF
C
      READ(NPATCH(7:7),'(A1)') ANUX
      I=(I1-2)*NY
      DO 13841 II=I1,I2
        I=I + NY
        DO 13842 J=J1,J2
          IJ1=I + J
          IJ2=IJ1 + KADD
          H11=A4(IJ1)
          H12=A4(IJ2)
          CP1=A2(IJ1)
          CP2=A2(IJ2)
          CO1=A5(IJ1)*A1(IJ1)*A3(IJ1)
          VA1=H12*CP1/CP2
          QDTTOT=QDTTOT + CO1*(VA1-H11)
          IF(ANUX.EQ.'1') QDOT01=QDOT01 + CO1*(VA1-H11)
          IF(ANUX.EQ.'2') QDOT02=QDOT02 + CO1*(VA1-H11)
          IF(ANUX.EQ.'3') QDOT03=QDOT03 + CO1*(VA1-H11)
          IF(ANUX.EQ.'4') QDOT04=QDOT04 + CO1*(VA1-H11)
13842   CONTINUE
13841 CONTINUE
C
      RETURN
  139 CONTINUE
C------------------- SECTION 10 ------------- coefficient = GRND9
      RETURN
 1310 CONTINUE
C------------------- SECTION 11 ------------- coefficient = GRND10
      RETURN
 1311 CONTINUE
C------------------- SECTION 12 ------------------- value = GRND
      RETURN
 1312 CONTINUE
C------------------- SECTION 13 -------------------- value = GRND1
      RETURN
 1313 CONTINUE
C------------------- SECTION 14 -------------------- value = GRND2
      RETURN
 1314 CONTINUE
C------------------- SECTION 15 -------------------- value = GRND3
      RETURN
 1315 CONTINUE
C------------------- SECTION 16 -------------------- value = GRND4
      RETURN
 1316 CONTINUE
C------------------- SECTION 17 -------------------- value = GRND5
      RETURN
 1317 CONTINUE
C------------------- SECTION 18 -------------------- value = GRND6
      RETURN
 1318 CONTINUE
C------------------- SECTION 19 -------------------- value = GRND7
      IF(INDVAR.LT.U1 .OR. INDVAR.GT.W2) GO TO 13189
      CALL GETYX(AUX(DEN1),A1,NY,NX)
      CALL GETYX(P1       ,A2,NY,NX)
      CALL GETCOV(NPATCH,INAME('UCRT'),COEFF,GKLOSS)
      CALL GETCOV(NPATCH, P1 ,COEFF,GPBV  )
      I=(IXF-2)*NY
      DO 13181 II=IXF,IXL
        I=I + NY
        DO 13182 J=IYF,IYL
          IJ=I + J
          DELTAP= A2(IJ)-GPBV
          ABSDP = ABS(DELTAP)
          RHO   = A1(IJ)
          VMAG  = SQRT(2.*ABSDP/(GKLOSS*RHO))
          A1(IJ)=-SIGN(VMAG,DELTAP)
13182   CONTINUE
13181 CONTINUE
      CALL SETYX(VAL,A1,NY,NX)
      RETURN
13189 CALL WRIT40('VAL = GRND7 FOR VARBLE BESIDES [U,V,W]1.')
      CALL WAYOUT(1)
      RETURN
 1319 CONTINUE
C------------------- SECTION 20 -------------------- value = GRND8
      CALL GETYX(H1,A1,NY,NX)
      CALL GETYX(CP,A2,NY,NX)
C
      I=(I1-2)*NY
      DO 13191 II=I1,I2
        I=I + NY
        DO 13192 J=J1,J2
          IJ1=I + J
          IJ2=IJ1 + KADD
          H11=A1(IJ1)
          H12=A1(IJ2)
          CP1=A2(IJ1)
          CP2=A2(IJ2)
          VA1=H12*CP1/CP2
          VA2=H11*CP2/CP1
          A3(IJ1)=VA1
          A3(IJ2)=VA2
13192   CONTINUE
13191 CONTINUE
C
      CALL SETYX(VAL,A3,NY,NX)
      RETURN
 1320 CONTINUE
C------------------- SECTION 21 -------------------- value = GRND9
      DO 13201 IX=1,NX
      DO 13201 IY=1,NY
      IF(NPATCH.EQ.'XDYNOIN')  PHI(IY,IX)=-RG(803)*XFCTD
      IF(NPATCH.EQ.'XDYNOUT')  PHI(IY,IX)=RG(803)*XFCTD
13201 CONTINUE
      CALL SETYX(VAL,PHI,JNY,JNX)
      RETURN
 1321 CONTINUE
C------------------- SECTION 22 -------------------- value = GRND10
      DO 13211 IX=1,NX
      DO 13211 IY=1,NY
      PHI(IY,IX)=RG(804)*XFCTE
      IF(NPATCH.EQ.'XENGIN') PHI(IY,IX)=-RG(804)*XFCTE
      IF(NPATCH.EQ.'XENGOUT') PHI(IY,IX)=RG(805)*XFCTE
13211 CONTINUE
      CALL SETYX(VAL,PHI,JNY,JNX)
      RETURN
C****************************************************************
C
C--- GROUP 14. Downstream pressure for PARAB=.TRUE.
C
   14 CONTINUE
      RETURN
C****************************************************************
C    * Make changes for this group only in group 19.
C--- GROUP 15. Termination of sweeps
C--- GROUP 16. Termination of iterations
C--- GROUP 17. Under-relaxation devices
C--- GROUP 18. Limits on variables or increments to them
C****************************************************************
C
C--- GROUP 19. Special calls to GROUND from EARTH
C
   19 GO TO (191,192,193,194,195,196,197,198),ISC
  191 CONTINUE
C    * ------------------ SECTION 1 ---- START OF TIME STEP.
C
C-pd---Misc-------------------------------------------------------
C
      IF(IG(999).EQ.1) STOP
      QDTTOT=0.0
      QDOTT1=0.0
      QDOTT2=0.0
      QDOTT3=0.0
      QDOTT4=0.0
      IPASS=0
      IRAXV=0
      IRAXT=0
      IRAXS=0
      XFCTD=1.0
      XFCTE=1.0
      ITST=TSTSWP
      INPR=NPRMON
      NPRMON=1
C
C-pd---Assign monitoring locations------------------------------------
C
      IXMON1 =IXMON
      IYMON1 =IYMON
      IZMON1 =IZMON
C
      IXMON2 =IG(11)
      IYMON2 =IG(12)
      IZMON2 =IG(13)
C
      IXMON3 =IG(14)
      IYMON3 =IG(15)
      IZMON3 =IG(16)
C
      IXMON4 =IG(17)
      IYMON4 =IG(18)
      IZMON4 =IG(19)
C
      IXMON5 =IG(20)
      IYMON5 =IG(21)
      IZMON5 =IG(22)
C
      IXMON6 =IG(23)
      IYMON6 =IG(24)
      IZMON6 =IG(25)
C
      IXMON7 =IG(26)
      IYMON7 =IG(27)
      IZMON7 =IG(28)
C
      IXMON8 =IG(29)
      IYMON8 =IG(30)
      IZMON8 =IG(31)
C
      IXMON9 =IG(32)
      IYMON9 =IG(33)
      IZMON9 =IG(34)
C
      IXMON10=IG(35)
      IYMON10=IG(36)
      IZMON10=IG(37)
C
      RETURN
  192 CONTINUE
C    * ------------------- SECTION 2 ---- START OF SWEEP.
C
C-pd---WARNING:  machine dependent------------------------------------
C
      call flush(6)
C
C-pd---Init-----------------------------------------------------------
C
      IF(ISWEEP.EQ.FSWEEP) SUMA=0.0
C
C-pd---Check to reset tstswp------------------------------------------
C
      IOPEN=0
      IF(ITST.NE.TSTSWP) IPASS=IPASS+1
      IF(IPASS.GT.10) THEN
        IPASS=0
        TSTSWP=ITST
      ENDIF
C
C-pd---Init stuff for printout of max and min-------------------------
C
      XP1MIN= 1000000.0
      XP1MAX=-1000000.0
      XU1MIN= 1000000.0
      XU1MAX=-1000000.0
      XV1MIN= 1000000.0
      XV1MAX=-1000000.0
      XW1MIN= 1000000.0
      XW1MAX=-1000000.0
      XKEMIN= 1000000.0
      XKEMAX=-1000000.0
      XEPMIN= 1000000.0
      XEPMAX=-1000000.0
      XH1MIN= 1000000.0
      XH1MAX=-1000000.0
      XT1MIN= 1000000.0
      XT1MAX=-1000000.0
      XETMIN= 1000000.0
      XETMAX=-1000000.0
      IXPMAX=0
      IYPMAX=0
      IZPMAX=0
      IXPMIN=0
      IYPMIN=0
      IZPMIN=0
      IXUMAX=0
      IYUMAX=0
      IZUMAX=0
      IXUMIN=0
      IYUMIN=0
      IZUMIN=0
      IXVMAX=0
      IYVMAX=0
      IZVMAX=0
      IXVMIN=0
      IYVMIN=0
      IZVMIN=0
      IXWMAX=0
      IYWMAX=0
      IZWMAX=0
      IXWMIN=0
      IYWMIN=0
      IZWMIN=0
      IXKMAX=0
      IYKMAX=0
      IZKMAX=0
      IXKMIN=0
      IYKMIN=0
      IZKMIN=0
      IXEMAX=0
      IYEMAX=0
      IZEMAX=0
      IXEMIN=0
      IYEMIN=0
      IZEMIN=0
      IXHMAX=0
      IYHMAX=0
      IZHMAX=0
      IXHMIN=0
      IYHMIN=0
      IZHMIN=0
      IXTMAX=0
      IYTMAX=0
      IZTMAX=0
      IXTMIN=0
      IYTMIN=0
      IZTMIN=0
      IXXMAX=0
      IYXMAX=0
      IZXMAX=0
      IXXMIN=0
      IYXMIN=0
      IZXMIN=0
C
      RETURN
  193 CONTINUE
C   * ------------------- SECTION 3 ---- START OF IZ SLAB.
      RETURN
  194 CONTINUE
C   * ------------------- SECTION 4 ---- START OF ITERATION.
C     IF(IRAXV.EQ.1) THEN
C       CALL XSETCV('RAX1', U1,XCOF,XVEL,RAXFTV,1.0)
C       CALL XSETCV('RAX1', V1,XCOF,XVEL,RAXFTV,1.0)
C       CALL XSETCV('RAX1', W1,XCOF,XVEL,RAXFTV,1.0)
C       WRITE(6,*)' CO FROM SETCV VEL -> ',XCOF
C       IRAXV=0
C     ENDIF
C     IF(IRAXT.EQ.1) THEN
C       CALL XSETCV('RAX1', KE,XCOF,XVEL,RAXFTT,1.0)
C       CALL XSETCV('RAX1', EP,XCOF,XVEL,RAXFTT,1.0)
C       WRITE(6,*)' CO FROM SETCV TUR -> ',XCOF
C       IRAXT=0
C     ENDIF
C     IF(IRAXS.EQ.1) THEN
C       CALL XSETCV('RAX1', H1,XCOF,XVEL,RAXFTS,1.0)
C       CALL XSETCV('RAX1', C1,XCOF,XVEL,RAXFTS,1.0)
C       CALL XSETCV('RAX1', C2,XCOF,XVEL,RAXFTS,1.0)
C       WRITE(6,*)' CO FROM SETCV SCA -> ',XCOF
C       IRAXS=0
C      ENDIF
C
C-pd---Modify inlet areas----------------------------------------------
C
      IF(ISWEEP.NE.FSWEEP) RETURN
      IF(IZ.GE.IG(704).AND.IZ.LE.IG(705)) THEN
        CALL GTIZYX(7,IZ,GAH,JNY,JNX)
        DO 19301 IX=IG(702),IG(703)
        SUMA=SUMA+GAH(IG(701),IX)
19301   CONTINUE
      ENDIF
C
      IF(IZ.EQ.IG(711)) THEN
        CALL GTIZYX(9,IZ,GAH,JNY,JNX)
        SUMB=0.0
        DO 19302 IX=IG(712),IG(713)
        DO 19302 IY=IG(714),IG(715)
        SUMB=SUMB+GAH(IY,IX)
19302   CONTINUE
      ENDIF
C
      IF(IZ.EQ.NZ) THEN
        XFCTD=RG(801)/SUMA
        XFCTE=RG(802)/SUMB
C       CALL XSETCV('XDYNOUT',P1,XCOF,XVEL,1.0,XFCTD)
C       CALL XSETCV('XENGOUT',P1,XCOF,XVEL,1.0,XFCTE)
C       CALL XSETCV('XDYNOIN',P1,XCOF,XVEL,1.0,XFCTD)
C       CALL XSETCV('XENGIN', P1,XCOF,XVEL,1.0,XFCTE)
      ENDIF
C
      RETURN
  195 CONTINUE
C   * -------------------- SECTION 5 ---- FINISH OF ITERATION.
      RETURN
  196 CONTINUE
C   * -------------------- SECTION 6 ---- FINISH OF IZ SLAB.
      IF (MOD(ISWEEP,IG(902)).NE.0.AND.ISWEEP.NE.LSWEEP-1) GOTO 1961
      IF(IZ.EQ.1) WRITE(6,*)' ==> CALCULATING ENGLISH UNITS '
C-pd---Dispensed by DBS for unknown reasons??????????????????????????
      CALL GETCAR
C     CALL BCARTC(1,1)
C
      CALL GETYX(P1,PHI,JNY,JNX)
      DO 19611 IX=1,NX
      DO 19611 IY=1,NY
19611 PHI(IY,IX)=PHI(IY,IX)*RG(36)
      CALL SETYX(PH2O,PHI,JNY,JNX)
C
      CALL GETYX(INAME('UCRT'),PHI,JNY,JNX)
      DO 19612 IX=1,NX
      DO 19612 IY=1,NY
19612 PHI(IY,IX)=PHI(IY,IX)*RG(37)
      CALL SETYX(U2,PHI,JNY,JNX)
C
      CALL GETYX(INAME('VCRT'),PHI,JNY,JNX)
      DO 19613 IX=1,NX
      DO 19613 IY=1,NY
19613 PHI(IY,IX)=PHI(IY,IX)*RG(37)
      CALL SETYX(V2,PHI,JNY,JNX)
C
      CALL GETYX(INAME('WCRT'),PHI,JNY,JNX)
      DO 19614 IX=1,NX
      DO 19614 IY=1,NY
19614 PHI(IY,IX)=PHI(IY,IX)*RG(37)
      CALL SETYX(W2,PHI,JNY,JNX)
C
      CALL GETYX(TEMP,PHI,JNY,JNX)
      DO 19615 IX=1,NX
      DO 19615 IY=1,NY
19615 PHI(IY,IX)=PHI(IY,IX)/RG(33)-RG(32)
      CALL SETYX(TFAR,PHI,JNY,JNX)
C
      CALL GETYX(AUX(DEN1),PHI,JNY,JNX)
      DO 19616 IX=1,NX
      DO 19616 IY=1,NY
19616 PHI(IY,IX)=PHI(IY,IX)*RG(38)
      CALL SETYX(RHOE,PHI,JNY,JNX)
C
C-pd---Find max and min-----------------------------------------------
C
 1961 IF(MOD(ISWEEP,NPRMON).EQ.0) THEN
        CALL GETYX(P1,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19617 IX=1,NX
        DO 19617 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19617
        IF(PHI(IY,IX).GT.XP1MAX) THEN
          XP1MAX=PHI(IY,IX)
          IXPMAX=IX
          IYPMAX=IY
          IZPMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XP1MIN) THEN
          XP1MIN=PHI(IY,IX)
          IXPMIN=IX
          IYPMIN=IY
          IZPMIN=IZ
        ENDIF
19617   CONTINUE
C
        CALL GETYX(U1,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19618 IX=1,NX
        DO 19618 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19618
        IF(PHI(IY,IX).GT.XU1MAX) THEN
          XU1MAX=PHI(IY,IX)
          IXUMAX=IX
          IYUMAX=IY
          IZUMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XU1MIN) THEN
          XU1MIN=PHI(IY,IX)
          IXUMIN=IX
          IYUMIN=IY
          IZUMIN=IZ
        ENDIF
19618   CONTINUE
C
        CALL GETYX(V1,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19619 IX=1,NX
        DO 19619 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19619
        IF(PHI(IY,IX).GT.XV1MAX) THEN
          XV1MAX=PHI(IY,IX)
          IXVMAX=IX
          IYVMAX=IY
          IZVMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XV1MIN) THEN
          XV1MIN=PHI(IY,IX)
          IXVMIN=IX
          IYVMIN=IY
          IZVMIN=IZ
        ENDIF
19619   CONTINUE
C
        CALL GETYX(W1,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19620 IX=1,NX
        DO 19620 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19620
        IF(PHI(IY,IX).GT.XW1MAX) THEN
          XW1MAX=PHI(IY,IX)
          IXWMAX=IX
          IYWMAX=IY
          IZWMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XW1MIN) THEN
          XW1MIN=PHI(IY,IX)
          IXWMIN=IX
          IYWMIN=IY
          IZWMIN=IZ
        ENDIF
19620   CONTINUE
C
        CALL GETYX(KE,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19621 IX=1,NX
        DO 19621 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19621
        IF(PHI(IY,IX).GT.XKEMAX) THEN
          XKEMAX=PHI(IY,IX)
          IXKMAX=IX
          IYKMAX=IY
          IZKMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XKEMIN) THEN
          XKEMIN=PHI(IY,IX)
          IXKMIN=IX
          IYKMIN=IY
          IZKMIN=IZ
        ENDIF
19621   CONTINUE
C
        CALL GETYX(EP,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19622 IX=1,NX
        DO 19622 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19622
        IF(PHI(IY,IX).GT.XEPMAX) THEN
          XEPMAX=PHI(IY,IX)
          IXEMAX=IX
          IYEMAX=IY
          IZEMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XEPMIN) THEN
          XEPMIN=PHI(IY,IX)
          IXEMIN=IX
          IYEMIN=IY
          IZEMIN=IZ
        ENDIF
19622   CONTINUE
```

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C
        CALL GETYX(H1,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19623 IX=1,NX
        DO 19623 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19623
        IF(PHI(IY,IX).GT.XH1MAX) THEN
          XH1MAX=PHI(IY,IX)
          IXHMAX=IX
          IYHMAX=IY
          IZHMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XH1MIN) THEN
          XH1MIN=PHI(IY,IX)
          IXHMIN=IX
          IYHMIN=IY
          IZHMIN=IZ
        ENDIF
19623   CONTINUE
C
        CALL GETYX(TEMP,PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19624 IX=1,NX
        DO 19624 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19624
        IF(PHI(IY,IX).GT.XT1MAX) THEN
          XT1MAX=PHI(IY,IX)
          IXTMAX=IX
          IYTMAX=IY
          IZTMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XT1MIN) THEN
          XT1MIN=PHI(IY,IX)
          IXTMIN=IX
          IYTMIN=IY
          IZTMIN=IZ
        ENDIF
19624   CONTINUE
C
        CALL GETYX(AUX(VIST),PHI,JNY,JNX)
        CALL GETYX (INAME('VPOR'),GVPR,JNY,JNX)
        DO 19625 IX=1,NX
        DO 19625 IY=1,NY
        IF (GVPR(IY,IX).LE.1.E-4) GOTO 19625
        IF(PHI(IY,IX).GT.XETMAX) THEN
          XETMAX=PHI(IY,IX)
          IXXMAX=IX
          IYXMAX=IY
          IZXMAX=IZ
        ENDIF
        IF(PHI(IY,IX).LT.XETMIN) THEN
          XETMIN=PHI(IY,IX)
          IXXMIN=IX
          IYXMIN=IY
          IZXMIN=IZ
        ENDIF
19625   CONTINUE
      ENDIF
C
C-pd---Get monitoring values------------------------------------------
```

```
C
      IF(MOD(ISWEEP,TSTSWP).NE.0) GOTO 19692
      IF(IZ.NE.IZMON1) GOTO 1962
        CALL GETONE(P1,PP1,IYMON1,IXMON1)
        CALL GETONE(U1,UU1,IYMON1,IXMON1)
        CALL GETONE(V1,VV1,IYMON1,IXMON1)
        CALL GETONE(W1,WW1,IYMON1,IXMON1)
        CALL GETONE(AUX(DEN1),DD1,IYMON1,IXMON1)
        IF(STORE(KE)) CALL GETONE(KE,KE1,IYMON1,IXMON1)
        IF(STORE(EP)) CALL GETONE(EP,EP1,IYMON1,IXMON1)
        IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET1,IYMON1,IXMON1)
        CALL GETONE(C1,C1C1,IYMON1,IXMON1)
        IF(STORE(C2)) CALL GETONE(C2,C2C1,IYMON1,IXMON1)
        IF(STORE(C3)) CALL GETONE(C3,C3C1,IYMON1,IXMON1)
        IF(STORE(CP)) CALL GETONE(CP,CPC1,IYMON1,IXMON1)
        IF(STORE(C11)) CALL GETONE(C11,CXC1,IYMON1,IXMON1)
        CALL GETONE(TEMP,C4C1,IYMON1,IXMON1)
        CALL GETONE(H1,H1H1,IYMON1,IXMON1)
 1962 IF(IZ.NE.IZMON2) GOTO 1963
        CALL GETONE(P1,PP2,IYMON2,IXMON2)
        CALL GETONE(U1,UU2,IYMON2,IXMON2)
        CALL GETONE(V1,VV2,IYMON2,IXMON2)
        CALL GETONE(W1,WW2,IYMON2,IXMON2)
        CALL GETONE(AUX(DEN1),DD2,IYMON2,IXMON2)
        IF(STORE(KE)) CALL GETONE(KE,KE2,IYMON2,IXMON2)
        IF(STORE(EP)) CALL GETONE(EP,EP2,IYMON2,IXMON2)
        IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET2,IYMON2,IXMON2)
        CALL GETONE(C1,C1C2,IYMON2,IXMON2)
        IF(STORE(C2)) CALL GETONE(C2,C2C2,IYMON2,IXMON2)
        IF(STORE(C3)) CALL GETONE(C3,C3C2,IYMON2,IXMON2)
        IF(STORE(CP)) CALL GETONE(CP,CPC2,IYMON2,IXMON2)
        IF(STORE(C11)) CALL GETONE(C11,CXC2,IYMON2,IXMON2)
        CALL GETONE(TEMP,C4C2,IYMON2,IXMON2)
        CALL GETONE(H1,H1H2,IYMON2,IXMON2)
 1963 IF(IZ.NE.IZMON3) GOTO 1964
        CALL GETONE(P1,PP3,IYMON3,IXMON3)
        CALL GETONE(U1,UU3,IYMON3,IXMON3)
        CALL GETONE(V1,VV3,IYMON3,IXMON3)
        CALL GETONE(W1,WW3,IYMON3,IXMON3)
        CALL GETONE(AUX(DEN1),DD3,IYMON3,IXMON3)
        IF(STORE(KE)) CALL GETONE(KE,KE3,IYMON3,IXMON3)
        IF(STORE(EP)) CALL GETONE(EP,EP3,IYMON3,IXMON3)
        IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET3,IYMON3,IXMON3)
        CALL GETONE(C1,C1C3,IYMON3,IXMON3)
        IF(STORE(C2)) CALL GETONE(C2,C2C3,IYMON3,IXMON3)
        IF(STORE(C3)) CALL GETONE(C3,C3C3,IYMON3,IXMON3)
        IF(STORE(CP)) CALL GETONE(CP,CPC3,IYMON3,IXMON3)
        IF(STORE(C11)) CALL GETONE(C11,CXC3,IYMON3,IXMON3)
        CALL GETONE(TEMP,C4C3,IYMON3,IXMON3)
        CALL GETONE(H1,H1H3,IYMON3,IXMON3)
 1964 IF(IZ.NE.IZMON4) GOTO 1965
        CALL GETONE(P1,PP4,IYMON4,IXMON4)
        CALL GETONE(U1,UU4,IYMON4,IXMON4)
        CALL GETONE(V1,VV4,IYMON4,IXMON4)
        CALL GETONE(W1,WW4,IYMON4,IXMON4)
        CALL GETONE(AUX(DEN1),DD4,IYMON4,IXMON4)
        IF(STORE(KE)) CALL GETONE(KE,KE4,IYMON4,IXMON4)
        IF(STORE(EP)) CALL GETONE(EP,EP4,IYMON4,IXMON4)
        IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET4,IYMON4,IXMON4)
        CALL GETONE(C1,C1C4,IYMON4,IXMON4)
      IF(STORE(C2)) CALL GETONE(C2,C2C4,IYMON4,IXMON4)
      IF(STORE(C3)) CALL GETONE(C3,C3C4,IYMON4,IXMON4)
      IF(STORE(CP)) CALL GETONE(CP,CPC4,IYMON4,IXMON4)
      IF(STORE(C11)) CALL GETONE(C11,CXC4,IYMON4,IXMON4)
      CALL GETONE(TEMP,C4C4,IYMON4,IXMON4)
      CALL GETONE(H1,H1H4,IYMON4,IXMON4)
 1965 IF(IZ.NE.IZMON5) GOTO 1966
      CALL GETONE(P1,PP5,IYMON5,IXMON5)
      CALL GETONE(U1,UU5,IYMON5,IXMON5)
      CALL GETONE(V1,VV5,IYMON5,IXMON5)
      CALL GETONE(W1,WW5,IYMON5,IXMON5)
      CALL GETONE(AUX(DEN1),DD5,IYMON5,IXMON5)
      IF(STORE(KE)) CALL GETONE(KE,KE5,IYMON5,IXMON5)
      IF(STORE(EP)) CALL GETONE(EP,EP5,IYMON5,IXMON5)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET5,IYMON5,IXMON5)
      CALL GETONE(C1,C1C5,IYMON5,IXMON5)
      IF(STORE(C2)) CALL GETONE(C2,C2C5,IYMON5,IXMON5)
      IF(STORE(C3)) CALL GETONE(C3,C3C5,IYMON5,IXMON5)
      IF(STORE(CP)) CALL GETONE(CP,CPC5,IYMON5,IXMON5)
      IF(STORE(C11)) CALL GETONE(C11,CXC5,IYMON5,IXMON5)
      CALL GETONE(TEMP,C4C5,IYMON5,IXMON5)
      CALL GETONE(H1,H1H5,IYMON5,IXMON5)
 1966 IF(IZ.NE.IZMON6) GOTO 1967
      CALL GETONE(P1,PP6,IYMON6,IXMON6)
      CALL GETONE(U1,UU6,IYMON6,IXMON6)
      CALL GETONE(V1,VV6,IYMON6,IXMON6)
      CALL GETONE(W1,WW6,IYMON6,IXMON6)
      CALL GETONE(AUX(DEN1),DD6,IYMON6,IXMON6)
      IF(STORE(KE)) CALL GETONE(KE,KE6,IYMON6,IXMON6)
      IF(STORE(EP)) CALL GETONE(EP,EP6,IYMON6,IXMON6)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET6,IYMON6,IXMON6)
      CALL GETONE(C1,C1C6,IYMON6,IXMON6)
      IF(STORE(C2)) CALL GETONE(C2,C2C6,IYMON6,IXMON6)
      IF(STORE(C3)) CALL GETONE(C3,C3C6,IYMON6,IXMON6)
      IF(STORE(CP)) CALL GETONE(CP,CPC6,IYMON6,IXMON6)
      IF(STORE(C11)) CALL GETONE(C11,CXC6,IYMON6,IXMON6)
      CALL GETONE(TEMP,C4C6,IYMON6,IXMON6)
      CALL GETONE(H1,H1H6,IYMON6,IXMON6)
 1967 IF(IZ.NE.IZMON7) GOTO 1968
      CALL GETONE(P1,PP7,IYMON7,IXMON7)
      CALL GETONE(U1,UU7,IYMON7,IXMON7)
      CALL GETONE(V1,VV7,IYMON7,IXMON7)
      CALL GETONE(W1,WW7,IYMON7,IXMON7)
      CALL GETONE(AUX(DEN1),DD7,IYMON7,IXMON7)
      IF(STORE(KE)) CALL GETONE(KE,KE7,IYMON7,IXMON7)
      IF(STORE(EP)) CALL GETONE(EP,EP7,IYMON7,IXMON7)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET7,IYMON7,IXMON7)
      CALL GETONE(C1,C1C7,IYMON7,IXMON7)
      IF(STORE(C2)) CALL GETONE(C2,C2C7,IYMON7,IXMON7)
      IF(STORE(C3)) CALL GETONE(C3,C3C7,IYMON7,IXMON7)
      IF(STORE(CP)) CALL GETONE(CP,CPC7,IYMON7,IXMON7)
      IF(STORE(C11)) CALL GETONE(C11,CXC7,IYMON7,IXMON7)
      CALL GETONE(TEMP,C4C7,IYMON7,IXMON7)
      CALL GETONE(H1,H1H7,IYMON7,IXMON7)
 1968 IF(IZ.NE.IZMON8) GOTO 1969
      CALL GETONE(P1,PP8,IYMON8,IXMON8)
      CALL GETONE(U1,UU8,IYMON8,IXMON8)
      CALL GETONE(V1,VV8,IYMON8,IXMON8)
      CALL GETONE(W1,WW8,IYMON8,IXMON8)
      CALL GETONE(AUX(DEN1),DD8,IYMON8,IXMON8)
      IF(STORE(KE)) CALL GETONE(KE,KE8,IYMON8,IXMON8)
      IF(STORE(EP)) CALL GETONE(EP,EP8,IYMON8,IXMON8)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET8,IYMON8,IXMON8)
      CALL GETONE(C1,C1C8,IYMON8,IXMON8)
      IF(STORE(C2)) CALL GETONE(C2,C2C8,IYMON8,IXMON8)
      IF(STORE(C3)) CALL GETONE(C3,C3C8,IYMON8,IXMON8)
      IF(STORE(CP)) CALL GETONE(CP,CPC8,IYMON8,IXMON8)
      IF(STORE(C11)) CALL GETONE(C11,CXC8,IYMON8,IXMON8)
      CALL GETONE(TEMP,C4C8,IYMON8,IXMON8)
      CALL GETONE(H1,H1H8,IYMON8,IXMON8)
 1969 IF(IZ.NE.IZMON9) GOTO 19691
      CALL GETONE(P1,PP9,IYMON9,IXMON9)
      CALL GETONE(U1,UU9,IYMON9,IXMON9)
      CALL GETONE(V1,VV9,IYMON9,IXMON9)
      CALL GETONE(W1,WW9,IYMON9,IXMON9)
      CALL GETONE(AUX(DEN1),DD9,IYMON9,IXMON9)
      IF(STORE(KE)) CALL GETONE(KE,KE9,IYMON9,IXMON9)
      IF(STORE(EP)) CALL GETONE(EP,EP9,IYMON9,IXMON9)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET9,IYMO91,IXMON9)
      CALL GETONE(C1,C1C9,IYMON9,IXMON9)
      IF(STORE(C2)) CALL GETONE(C2,C2C9,IYMON9,IXMON9)
      IF(STORE(C3)) CALL GETONE(C3,C3C9,IYMON9,IXMON9)
      IF(STORE(CP)) CALL GETONE(CP,CPC9,IYMON9,IXMON9)
      IF(STORE(C11)) CALL GETONE(C11,CXC9,IYMON9,IXMON9)
      CALL GETONE(TEMP,C4C9,IYMON9,IXMON9)
      CALL GETONE(H1,H1H9,IYMON9,IXMON9)
19691 IF(IZ.NE.IZMON10) GOTO 19692
      CALL GETONE(P1,PP10,IYMON10,IXMON10)
      CALL GETONE(U1,UU10,IYMON10,IXMON10)
      CALL GETONE(V1,VV10,IYMON10,IXMON10)
      CALL GETONE(W1,WW10,IYMON10,IXMON10)
      CALL GETONE(AUX(DEN1),DD10,IYMON10,IXMON10)
      IF(STORE(KE)) CALL GETONE(KE,KE10,IYMON10,IXMON10)
      IF(STORE(EP)) CALL GETONE(EP,EP10,IYMON10,IXMON10)
      IF(STORE(AUX(VIST))) CALL GETONE(AUX(VIST),ET10,IYMON10,IXMON10)
      CALL GETONE(C1,C1C10,IYMON10,IXMON10)
      IF(STORE(C2)) CALL GETONE(C2,C2C10,IYMON10,IXMON10)
      IF(STORE(C3)) CALL GETONE(C3,C3C10,IYMON10,IXMON10)
      IF(STORE(CP)) CALL GETONE(CP,CPC10,IYMON10,IXMON10)
      IF(STORE(C11)) CALL GETONE(C11,CXC10,IYMON10,IXMON10)
      CALL GETONE(TEMP,C4C10,IYMON10,IXMON10)
      CALL GETONE(H1,H1H10,IYMON10,IXMON10)
19692 CONTINUE
C
      RETURN
  197 CONTINUE
C   * ------------------- SECTION 7 ---- FINISH OF SWEEP.
C
C-pd---Printout of monitoring locations------------------------------
C
      IF(MOD(ISWEEP,TSTSWP).EQ.0.AND.IG(38).EQ.1) WRITE(6,1977)
     &   IXMON1,IYMON1,IZMON1,PP1,UU1,VV1,WW1,DD1,
     &   IXMON2,IYMON2,IZMON2,PP2,UU2,VV2,WW2,DD2,
     &   IXMON3,IYMON3,IZMON3,PP3,UU3,VV3,WW3,DD3,
     &   IXMON4,IYMON4,IZMON4,PP4,UU4,VV4,WW4,DD4,
     &   IXMON5,IYMON5,IZMON5,PP5,UU5,VV5,WW5,DD5,
     &   IXMON6,IYMON6,IZMON6,PP6,UU6,VV6,WW6,DD6,
     &   IXMON7,IYMON7,IZMON7,PP7,UU7,VV7,WW7,DD7,
     &   IXMON8,IYMON8,IZMON8,PP8,UU8,VV8,WW8,DD8,
     &   IXMON9,IYMON9,IZMON9,PP9,UU9,VV9,WW9,DD9,
     &   IXMON10,IYMON10,IZMON10,PP10,UU10,VV10,WW10,DD10
 1977  FORMAT(1X,'MONITORING VALUES :'2X,'P1',11X,'U1',11X,'V1',11X,
     &   'W1',10X,'RHO1'/,10(1X,'AT(',I2,',',I2,',',I2,'):'1P,5E13.5:,/))
      IF(MOD(ISWEEP,TSTSWP).EQ.0.AND.IG(39).EQ.1) WRITE(6,1978)
     &   IXMON1,IYMON1,IZMON1,KE1,EP1,C1C1,ET1,C4C1,
     &   IXMON2,IYMON2,IZMON2,KE2,EP2,C1C2,ET2,C4C2,
     &   IXMON3,IYMON3,IZMON3,KE3,EP3,C1C3,ET3,C4C3,
     &   IXMON4,IYMON4,IZMON4,KE4,EP4,C1C4,ET4,C4C4,
     &   IXMON5,IYMON5,IZMON5,KE5,EP5,C1C5,ET5,C4C5,
     &   IXMON6,IYMON6,IZMON6,KE6,EP6,C1C6,ET6,C4C6,
     &   IXMON7,IYMON7,IZMON7,KE7,EP7,C1C7,ET7,C4C7,
     &   IXMON8,IYMON8,IZMON8,KE8,EP8,C1C8,ET8,C4C8,
     &   IXMON9,IYMON9,IZMON9,KE9,EP9,C1C9,ET9,C4C9,
     &   IXMON10,IYMON10,IZMON10,KE10,EP10,C1C10,ET10,C4C10
 1978  FORMAT(1X,'MONITORING VALUES :'2X,'KE',11X,'EP',11X,'C1',10X,
     &   'ENUT',9X,'TEMP'/,10(1X,'LO(',I2,',',I2,',',I2,'):'1P,5E13.5:,/))
      IF(MOD(ISWEEP,TSTSWP).EQ.0.AND.IG(40).EQ.1) WRITE(6,1979)
     &   IXMON1,IYMON1,IZMON1,H1H1,C2C1,C3C1,CPC1,CXC1,
     &   IXMON2,IYMON2,IZMON2,H1H2,C2C2,C3C2,CPC2,CXC2,
     &   IXMON3,IYMON3,IZMON3,H1H3,C2C3,C3C3,CPC3,CXC3,
     &   IXMON4,IYMON4,IZMON4,H1H4,C2C4,C3C4,CPC4,CXC4,
     &   IXMON5,IYMON5,IZMON5,H1H5,C2C5,C3C5,CPC5,CXC5,
     &   IXMON6,IYMON6,IZMON6,H1H6,C2C6,C3C6,CPC6,CXC6,
     &   IXMON7,IYMON7,IZMON7,H1H7,C2C7,C3C7,CPC7,CXC7,
     &   IXMON8,IYMON8,IZMON8,H1H8,C2C8,C3C8,CPC8,CXC8,
     &   IXMON9,IYMON9,IZMON9,H1H9,C2C9,C3C9,CPC9,CXC9,
     &   IXMON10,IYMON10,IZMON10,H1H10,C2C10,C3C10,CPC10,CXC10
 1979  FORMAT(1X,'MONITORING VALUES :'2X,'H1',11X,'C2',11X,'C3',11X,
     &   'CP',10X,'SPAR'/,10(1X,'PT(',I2,',',I2,',',I2,'):'1P,5E13.5:,/))
C
C-pd---Printout heat info-----------------------------------------
C
      IF (IG(41).EQ.1) THEN
        CALL GETSOR('HEATTR1E',H1,QDOT1)
        CALL GETSOR('HEATTR1W',H1,QDOT2)
        CALL GETSOR('HEATTR1N',H1,QDOT3)
        CALL GETSOR('HEATTR1S',H1,QDOT4)
        CALL WRITBL
        CALL WRIT4R(' Qdot 1 ',QDOT1,',Qdot 2 ',QDOT2,
     &              ',Qdot 3 ',QDOT3,',Qdot 4 ',QDOT4)
      ENDIF
C
C-pd---Printout sorc and calc pumping ratio---------------------------
C
      IF(MOD(ISWEEP,NPRMON).EQ.0) THEN
        CALL GETSOR('XDYNOUT',R1,XMDOT1)
        CALL GETSOR('XOPEN2', R1,XMDOT2)
        CALL GETSOR('XENGOUT',R1,XMDOT3)
        CALL GETSOR('XOPEN3', R1,XMDOT4)
        CALL GETSOR('XDYNOIN',R1,XMDOT5)
        CALL GETSOR('XENGIN', R1,XMDOT6)
        CALL GETSOR('XOPEN1', R1,XMDOT7)
        CALL GETSOR('XDYNOUT',V1,XVVEL1)
        CALL GETSOR('XENGOUT',W1,XWVEL1)
        XPR1=(-XMDOT2-XMDOT1)/XMDOT1
        XPR2=(-XMDOT4-XMDOT3)/XMDOT3
        XERR1=RESD(P1)*RESREF(P1)*RG(701)*100.0/XMDOT7
        XERR2=RESD(W1)*RESREF(W1)*100.0/(XWVEL1+XVVEL1)
        CALL WRIT4R(' Mdot 1 ',XMDOT1,',Mdot 2 ',XMDOT2,
     &              ',Mdot 3 ',XMDOT3,',Mdot 4 ',XMDOT4)
```

```
        CALL WRIT2R(' PR Dyn ',XPR1,',PR Eng ',XPR2)
        CALL WRIT4R(' DYNO IN',XMDOT5/RG(35),',DYN OUT',XMDOT1/RG(35),
     &              ',ENG  IN',XMDOT6/RG(35),',ENG OUT',XMDOT3/RG(35))
        XFUL=(XMDOT3+XMDOT6)/RG(35)
        CALL WRIT1R(' FUEL IN',XFUL)
        CALL WRIT2R(' ErrMdot',XERR1,',ErrVel ',XERR2)
      ENDIF
C
C-pd---Printout max and min--------------------------------------------
C
      IF(MOD(ISWEEP,NPRMON).EQ.0) THEN
        WRITE(6,*)'  P1MAX  LOC ',XP1MAX,IXPMAX,IYPMAX,IZPMAX
        WRITE(6,*)'  P1MIN  LOC ',XP1MIN,IXPMIN,IYPMIN,IZPMIN
        WRITE(6,*)'  U1MAX  LOC ',XU1MAX,IXUMAX,IYUMAX,IZUMAX
        WRITE(6,*)'  U1MIN  LOC ',XU1MIN,IXUMIN,IYUMIN,IZUMIN
        WRITE(6,*)'  V1MAX  LOC ',XV1MAX,IXVMAX,IYVMAX,IZVMAX
        WRITE(6,*)'  V1MIN  LOC ',XV1MIN,IXVMIN,IYVMIN,IZVMIN
        WRITE(6,*)'  W1MAX  LOC ',XW1MAX,IXWMAX,IYWMAX,IZWMAX
        WRITE(6,*)'  W1MIN  LOC ',XW1MIN,IXWMIN,IYWMIN,IZWMIN
        WRITE(6,*)'  H1MAX  LOC ',XH1MAX,IXHMAX,IYHMAX,IZHMAX
        WRITE(6,*)'  H1MIN  LOC ',XH1MIN,IXHMIN,IYHMIN,IZHMIN
        WRITE(6,*)'  T1MAX  LOC ',XT1MAX,IXTMAX,IYTMAX,IZTMAX
        WRITE(6,*)'  T1MIN  LOC ',XT1MIN,IXTMIN,IYTMIN,IZTMIN
        WRITE(6,*)'  KEMAX  LOC ',XKEMAX,IXKMAX,IYKMAX,IZKMAX
C       WRITE(6,*)'  KEMIN  LOC ',XKEMIN,IXKMIN,IYKMIN,IZKMIN
        WRITE(6,*)'  EPMAX  LOC ',XEPMAX,IXEMAX,IYEMAX,IZEMAX
C       WRITE(6,*)'  EPMIN  LOC ',XEPMIN,IXEMIN,IYEMIN,IZEMIN
        WRITE(6,*)'  ETMAX  LOC ',XETMAX,IXXMAX,IYXMAX,IZXMAX
C       WRITE(6,*)'  ETMIN  LOC ',XETMIN,IXXMIN,IYXMIN,IZXMIN
      ENDIF
      IF(ISWEEP.EQ.FSWEEP+2) NPRMON=INPR
      IF(MOD(ISWEEP,TSTSWP).NE.0) WRITE(6,*)' ISWEEP = ',ISWEEP
C
C-pd---Printout heat total---------------------------------------------
C
      IF(ISWEEP.EQ.LSWEEP.OR.MOD(ISWEEP,IG(901)).EQ.0) THEN
        CALL WRITBL
        CALL WRIT1R('Qdot,Tot',QDTTOT)
        CALL WRIT4R(' QTOT 1 ',QDOT01,',QTOT 2 ',QDOT02,
     &              ',QTOT 3 ',QDOT03,',QTOT 4 ',QDOT04)
        QDTTOT=0.0
        QDOT01=0.0
        QDOT02=0.0
        QDOT03=0.0
        QDOT04=0.0
        CALL WRITBL
      ENDIF
C
C-pd---Check to stop run-----------------------------------------------
C
      INQUIRE(FILE='ABORT',EXIST=LSG1)
      IF(LSG1) THEN
        OPEN(91,FILE='ABORT')
        CLOSE(91,STATUS='DELETE')
        LSWEEP=ISWEEP+2
        WRITE(6,*)' ==> ABORT CALLED:  STOP IN 2 SWEEPS '
        LSG1=.FALSE.
      ENDIF
C
C-pd---Modify relaxation without killing run--------------------------
```

```
C
      INQUIRE(FILE='RELAXP',EXIST=LSG2)
      IF(LSG2) THEN
        OPEN(92,FILE='RELAXP')
        WRITE(6,*)' ==> MODIFYING RELAX P1          OLD VALVE=',
     &             DTFALS(P1)
        READ(92,1971)XRELP1
        DTFALS(P1)=XRELP1
        CLOSE(92,STATUS='DELETE')
        WRITE(6,*)' ==>             ISWEEP    &     NEW VALVE=',
     &             DTFALS(P1),ISWEEP
        ITST=TSTSWP
        TSTSWP=1
        IOPEN=1
        LSG2=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RELAXT',EXIST=LSG3)
      IF(LSG3) THEN
        OPEN(93,FILE='RELAXT')
        WRITE(6,*)' ==> MODIFYING RELAX KE & EP    OLD VALVES=',
     &             DTFALS(KE),DTFALS(EP)
        READ(93,1972)XRELKE,XRELEP
        DTFALS(KE)=XRELKE
        DTFALS(EP)=XRELEP
        CLOSE(93,STATUS='DELETE')
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVES=',
     &             DTFALS(KE),DTFALS(EP),ISWEEP
        IF(IOPEN.EQ.0) THEN
          ITST=TSTSWP
          TSTSWP=1
          IOPEN=1
        ENDIF
        LSG3=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RELAXS',EXIST=LSG4)
      IF(LSG4) THEN
        OPEN(94,FILE='RELAXS')
        IF(SOLVE(C2)) THEN
        WRITE(6,*)' ==> MODIFYING RELAX H1 C1 & C2 OLD VALVES=',
     &             DTFALS(H1),DTFALS(C1),DTFALS(C2)
          READ(94,1973)XRELH1,XRELC1,XRELC2
          DTFALS(H1)=XRELH1
          DTFALS(C1)=XRELC1
          DTFALS(C2)=XRELC2
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVES=',
     &            DTFALS(H1),DTFALS(C1),DTFALS(C2),ISWEEP
        ELSE
        WRITE(6,*)' ==> MODIFYING RELAX H1 & C1    OLD VALVES=',
     &             DTFALS(H1),DTFALS(C1)
          READ(94,1972)XRELH1,XRELC1
          DTFALS(H1)=XRELH1
          DTFALS(C1)=XRELC1
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVES=',
     &             DTFALS(H1),DTFALS(C1),ISWEEP
        ENDIF
        CLOSE(94,STATUS='DELETE')
        IF(IOPEN.EQ.0) THEN
          ITST=TSTSWP
          TSTSWP=1
          IOPEN=1
        ENDIF
        LSG4=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RELAXV',EXIST=LSG5)
      IF(LSG5) THEN
        OPEN(95,FILE='RELAXV')
        WRITE(6,*)' ==> MODIFYING RELAX U1 V1 & W1 OLD VALVES=',
     &             DTFALS(U1),DTFALS(V1),DTFALS(W1)
        READ(95,1973)XRELU1,XRELV1,XRELW1
        DTFALS(U1)=XRELU1
        DTFALS(V1)=XRELV1
        DTFALS(W1)=XRELW1
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVES=',
     &             DTFALS(U1),DTFALS(V1),DTFALS(W1),ISWEEP
        CLOSE(95,STATUS='DELETE')
        IF(IOPEN.EQ.0) THEN
          ITST=TSTSWP
          TSTSWP=1
          IOPEN=1
        ENDIF
        LSG5=.FALSE.
      ENDIF
C
      INQUIRE(FILE='DUMPIT',EXIST=LSG6)
      IF(LSG6) THEN
        OPEN(96,FILE='DUMPIT')
        CLOSE(96,STATUS='DELETE')
        CALL AUTCHA(ISWEEP)
        LSG6=.FALSE.
      ELSEIF (MOD(ISWEEP,IG(902)).EQ.0) THEN
        CALL AUTCHA(ISWEEP)
      ENDIF
C
      INQUIRE(FILE='TSTMOD',EXIST=LSG7)
      IF(LSG7) THEN
        OPEN(97,FILE='TSTMOD')
        WRITE(6,*)' ==> MODIFYING TSTSWP           OLD VALVE=',
     &             TSTSWP
        READ(97,1974)TSTSWP
        IF(IOPEN.EQ.0) THEN
          ITST=TSTSWP
          IOPEN=1
        ENDIF
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVE=',
     &             TSTSWP,ISWEEP
        CLOSE(97,STATUS='DELETE')
        LSG7=.FALSE.
      ENDIF
C
      INQUIRE(FILE='NPRMOD',EXIST=LSG8)
      IF(LSG8) THEN
        OPEN(98,FILE='NPRMOD')
        WRITE(6,*)' ==> MODIFYING NPRMON           OLD VALVE=',
     &             NPRMON
        READ(98,1974)NPRMON
        WRITE(6,*)' ==>             ISWEEP    &    NEW VALVE=',
     &             NPRMON,ISWEEP
```

```
        CLOSE(98,STATUS='DELETE')
        LSG8=.FALSE.
      ENDIF
C
      INQUIRE(FILE='IGGMOD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(99,FILE='IGGMOD')
        WRITE(6,*)' ==> MODIFYING IG(38-41)         OLD VALVES=',
     &             IG(38),IG(39),IG(40),IG(41)
        READ(99,1975)IG(38),IG(39),IG(40),IG(41)
        WRITE(6,*)' ==>              ISWEEP     &    NEW VALVES=',
     &             IG(38),IG(39),IG(40),IG(41),ISWEEP
        CLOSE(99,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
      INQUIRE(FILE='ML2MOD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(100,FILE='ML2MOD')
        WRITE(6,*)' ==> MODIFYING IXYZMON2          OLD VALVES=',
     &             IXMON2,IYMON2,IZMON2
        READ(100,1976)IXMON2,IYMON2,IZMON2
        WRITE(6,*)' ==>              ISWEEP     &    NEW VALVES=',
     &             IXMON2,IYMON2,IZMON2,ISWEEP
        CLOSE(100,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
      INQUIRE(FILE='ML3MOD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(101,FILE='ML3MOD')
        WRITE(6,*)' ==> MODIFYING IXYZMON3          OLD VALVES=',
     &             IXMON3,IYMON3,IZMON3
        READ(101,1976)IXMON3,IYMON3,IZMON3
        WRITE(6,*)' ==>              ISWEEP     &    NEW VALVES=',
     &             IXMON3,IYMON3,IZMON3,ISWEEP
        CLOSE(101,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RAXVMD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(102,FILE='RAXVMD')
        WRITE(6,*)' ==> READING MODIFICATION FOR RAX VEL '
        READ(102,1971)RAXFTV
        WRITE(6,*)' ==>              ISWEEP     &        FACTOR=',
     &             RAXFTV,ISWEEP
        IRAXV=1
        CLOSE(102,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RAXTMD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(102,FILE='RAXTMD')
        WRITE(6,*)' ==> READING MODIFICATION FOR RAX TURB '
        READ(102,1971)RAXFTT
        WRITE(6,*)' ==>              ISWEEP     &        FACTOR=',
     &             RAXFTT,ISWEEP
        IRAXT=1
        CLOSE(102,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
      INQUIRE(FILE='RAXSMD',EXIST=LSG9)
      IF(LSG9) THEN
        OPEN(102,FILE='RAXSMD')
        WRITE(6,*)' ==> READING MODIFICATION FOR RAX SCAL '
        READ(102,1971)RAXFTS
        WRITE(6,*)' ==>             ISWEEP    &        FACTOR=',
     &             RAXFTS,ISWEEP
        IRAXS=1
        CLOSE(102,STATUS='DELETE')
        LSG9=.FALSE.
      ENDIF
C
 1971 FORMAT(F12.8)
 1972 FORMAT(2F12.8)
 1973 FORMAT(3F12.8)
 1974 FORMAT(I5)
 1975 FORMAT(4I2)
 1976 FORMAT(3I3)
C
      RETURN
  198 CONTINUE
C   * ------------------- SECTION 8 ---- FINISH OF TIME STEP.
      RETURN
C****************************************************************
C
C--- GROUP 20. Preliminary print-out
C
   20 CONTINUE
      RETURN
C****************************************************************
C   * Make changes for this group only in group 19.
C--- GROUP 21. Print-out of variables
C--- GROUP 22. Spot-value print-out
C****************************************************************
C
C--- GROUP 23. Field print-out and plot control
   23 CONTINUE
      RETURN
C****************************************************************
C
C--- GROUP 24. Dumps for restarts
C
   24 CONTINUE
      RETURN
      END
C************************************************************************
      SUBROUTINE TEMPER(HSTAT,T0,T,CPDR,RGAS,SC,NSC,NFO)
C************************************************************************
C  TEMPER uses an iterative procedure to calculate temperature
C  given H1 and a guess for temperature
C----------------------------------------------------------------------
C
      DIMENSION SC(NSC)
      DATA NITER,DT0,TMIN/12,50.,12.345/
C
      CALL ENTHAL(T0,HHH,CPDR,SC,NSC,NFO)
```

```
C
      CP=CPDR*RGAS
      ENTH=CP*T0
      DT=(HSTAT-ENTH)/(CP+1.E-15)
      TEMPL=T0
      IF(NFO.GE.4) WRITE(6,900) T0,ENTH,HSTAT,RGAS,SC(1),SC(2),SC(3)
      TEMP =T0+DT
      ITER=0
  100 ENTHL=ENTH
      ITER=ITER+1
      CALL ENTHAL(TEMP,HHH,CPDR,SC,NSC,NFO)
      ENTH=CPDR*RGAS*TEMP
      RENTH=(HSTAT-ENTHL)/((ENTH-ENTHL) +1.E-9)
      IF(NFO.GE.4) WRITE(6,910) ITER,TEMP,ENTH,ENTHL,HSTAT,RENTH
      IF(ABS(ENTH-ENTHL).LT..001*ABS(ENTH)) RENTH=1.
      TEMP1=TEMPL+(TEMP-TEMPL)*RENTH
      TEMP1=AMAX1(TEMP1,.5*TEMP,TMIN)
      TEMP1=AMIN1(TEMP1,1.5*TEMP,5000.)
      TEMPL=TEMP
      TEMP=TEMP1
      AR=ABS(RENTH)
      IF( (AR.GT.1.005 .OR. AR.LT..995) .AND. ITER.LT.NITER) GO TO 100
      T=TEMP
      RETURN
C
  900 FORMAT(' T0 E HS RG SC',1P,7E12.4)
  910 FORMAT(' IT T E EL HS RE',I3,1P,5E12.4)
C
      END
C
C***********************************************************************
      SUBROUTINE ENTHAL(TEMP,HSUM,CPSUM,SC,N  NFO)
C***********************************************************************
C  ENTHAL calculates H/RT from JANNAF data.  The order of
C  species is N O C H.
C-----------------------------------------------------------------------
C
      DIMENSION SC(*),ZS(7,2,4)
      DATA ZS/ 0.28532899E+01,  0.16022128E-02, -0.62936893E-06,
     &          0.11441022E-09, -0.78057465E-14, -0.89008093E+03,
     &          0.63964897E+01,  0.37044177E+01, -0.14218753E-02,
     &          0.28670392E-05, -0.12028885E-08, -0.13954677E-13,
     &         -0.10640795E+04,  0.22336285E+01,
     &          0.36122139E+01,  0.74853166E-03, -0.19820647E-06,
     &          0.33749008E-10, -0.23907374E-14, -0.11978151E+04,
     &          0.36703307E+01,  0.37837135E+01, -0.30233634E-02,
     &          0.99492751E-05, -0.98189101E-08,  0.33031825E-11,
     &         -0.10638107E+04,  0.36416345E+01,
     &          0.44608041E+01,  0.30981719E-02, -0.12392571E-05,
     &          0.22741325E-09, -0.15525954E-13, -0.48961442E+05,
     &         -0.98635982E+00,  0.24007797E+01,  0.87350957E-02,
     &         -0.66070878E-05,  0.20021861E-08,  0.63274039E-15,
     &         -0.48377527E+05,  0.96951457E+01,
     &          0.27167633E+01,  0.29451374E-02, -0.80224374E-06,
     &          0.10226682E-09, -0.48472145E-14, -0.29905826E 05,
     &          0.66305671E+01,  0.40701275E+01, -0.11084499E-02,
     &          0.41521180E-05, -0.29637404E-08,  0.80702103E-12,
     &         -0.30279722E+05, -0.32270046E+00 /
C
      K=1
      IF(TEMP.LT.1000.) K=2
      TEMP2=TEMP*TEMP
      HSUM=0.
      CPSUM=0.
      DO 100 IS=1,NS
      CP1=ZS(1,K,IS)
      CP2=ZS(2,K,IS)*TEMP
      CP3=ZS(3,K,IS)*TEMP2
      CP4=ZS(4,K,IS)*TEMP2*TEMP
      CP5=ZS(5,K,IS)*TEMP2*TEMP2
      CPSUM=CPSUM+SC(IS)*(CP1+CP2+CP3+CP4+CP5)
  100 HSUM =HSUM+
     1  SC(IS)*(CP1+.5*CP2+.33333*CP3+.25*CP4+.2*CP5+ZS(6,K,IS)/TEMP)
C
      RETURN
      END
C
C*********************************************************************
C     SUBROUTINE XGETCV(N,M,C,V)
C*********************************************************************
C  XGETCV used to set up procedure to get a patch co and val.
C-------------------------------------------------------------------
C
C     COMMON/IDATA/IDFIL1(70),NUMREG,IDFIL2(49)
C     COMMON/NPAT/NAMPAT(100)
C     CHARACTER N*(*),NAMPAT*8
C
C     IR=IRPAT(N)
C     CALL XCV(IR,M,C,V)
C
C     RETURN
C     END
C
C*********************************************************************
C     SUBROUTINE XCV(IR,MPHID,C,V)
C*********************************************************************
C  XCV used to get a patch co and val.
C-------------------------------------------------------------------
C
C     COMMON F(1)
C     COMMON/ICOVL/M04,IOPHI
C     LOGICAL QLT
C     INCLUDE 'SATEAR'
C
C     MPHI=MPHID
C     IO=0
C         IF(EARTH) IO=IORTCV
C         IF(QLT(F(IO+10*IR-8),23.0).AND.MPHI.LE.2) MPHI=MPHI+8
C     IOPHI=IORCV(MPHI)
C         IF(IOPHI.EQ.IO+NRTCV) GO TO 5
C     IOPHI=IOPHI-4
C       DO 2 I=1,NUMREG
C     IOPHI=IOPHI+4
C     IOL=IORCVL(MPHI)
C         IF(EARTH) IOL=IOL+IORCVF(MPHI)-4
C         IF(IOPHI.EQ.IOL+4) GO TO 5
C         IF(IABS(IFIX(F(IOPHI+1))).NE.IR) GO TO 2
C     C=F(IOPHI+2)
C     V=F(IOPHI+3)
C     GO TO 7
```

```
C  2 CONTINUE
C  5 C=-999.0
C    V=0.0
C  7 CONTINUE
C
C    RETURN
C    END
C
C***********************************************************************
C    SUBROUTINE XSETCV(N,M,C,V,CF,VF)
C***********************************************************************
C XGETCV used to set up procedure to modify a patch co and val.
C----------------------------------------------------------------------
C
C    COMMON/IDATA/IDFIL1(70),NUMREG,IDFIL2(49)
C    COMMON/NPAT/NAMPAT(100)
C    CHARACTER N*(*),NAMPAT*8
C
C    IR=IRPAT(N)
C    CALL XSCV(IR,M,C,V,CF,VF)
C
C
C    RETURN
C    END
C
C***********************************************************************
C    SUBROUTINE XSCV(IR,MPHID,C,V,CF,VF)
C***********************************************************************
C XCV used to get a patch co and val.
C----------------------------------------------------------------------
C
C    COMMON F(1)
C    COMMON/ICOVL/M04,IOPHI
C    LOGICAL QLT
C    INCLUDE 'SATEAR'
C
C    MPHI=MPHID
C    IO=0
C      IF(EARTH) IO=IORTCV
C      IF(QLT(F(IO+10*IR-8),23.0).AND.MPHI.LE.2) MPHI=MPHI+8
C    IOPHI=IORCV(MPHI)
C      IF(IOPHI.EQ.IO+NRTCV) GO TO 5
C    IOPHI=IOPHI-4
C     DO 2 I=1,NUMREG
C    IOPHI=IOPHI+4
C    IOL=IORCVL(MPHI)
C      IF(EARTH) IOL=IOL+IORCVF(MPHI)-4
C      IF(IOPHI.EQ.IOL+4) GO TO 5
C      IF(IABS(IFIX(F(IOPHI+1))).NE.IR) GO TO 2
C    C=F(IOPHI+2)
C    V=F(IOPHI+3)
C    WRITE(6,*)' IN SETCV   VAR & OLD VALUES= ',MPHI,C,V
C    F(IOPHI+2)=F(IOPHI+2)*CF
C    F(IOPHI+3)=F(IOPHI+3)*VF
C    C=F(IOPHI+2)
C    V=F(IOPHI+3)
C    WRITE(6,*)' IN SETCV   VAR & NEW VALUES= ',MPHI,C,V
C    GO TO 7
C  2  CONTINUE
C  5 C=-999.0
```

```
C     V=0.0
C   7 CONTINUE
C
C     RETURN
C     END
C
C************************************************************************
      SUBROUTINE AUTCHA(ISW)
C************************************************************************
C  AUTUCH writes phida file.
C----------------------------------------------------------------------
      DIMENSION JDATE(6)
C
      CALL DUMP
C-pd---WARNING:  The following two calls may be machine dependent-----
      CALL IDATE(JDATE(1))
      CALL ITIME(JDATE(4))
      WRITE(6,*)' **** DUMP CALLED ****    ISWEEP=',ISW
      WRITE(6,*)'  DAY  MONTH  YEAR    +++    HOUR  MINUTE   SECOND'
      WRITE(6,1974)JDATE
 1974 FORMAT(I4,I6,I8,8X,I6,I7,I8)
C----------------------------------------------------------------------
C
      RETURN
      END
```

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